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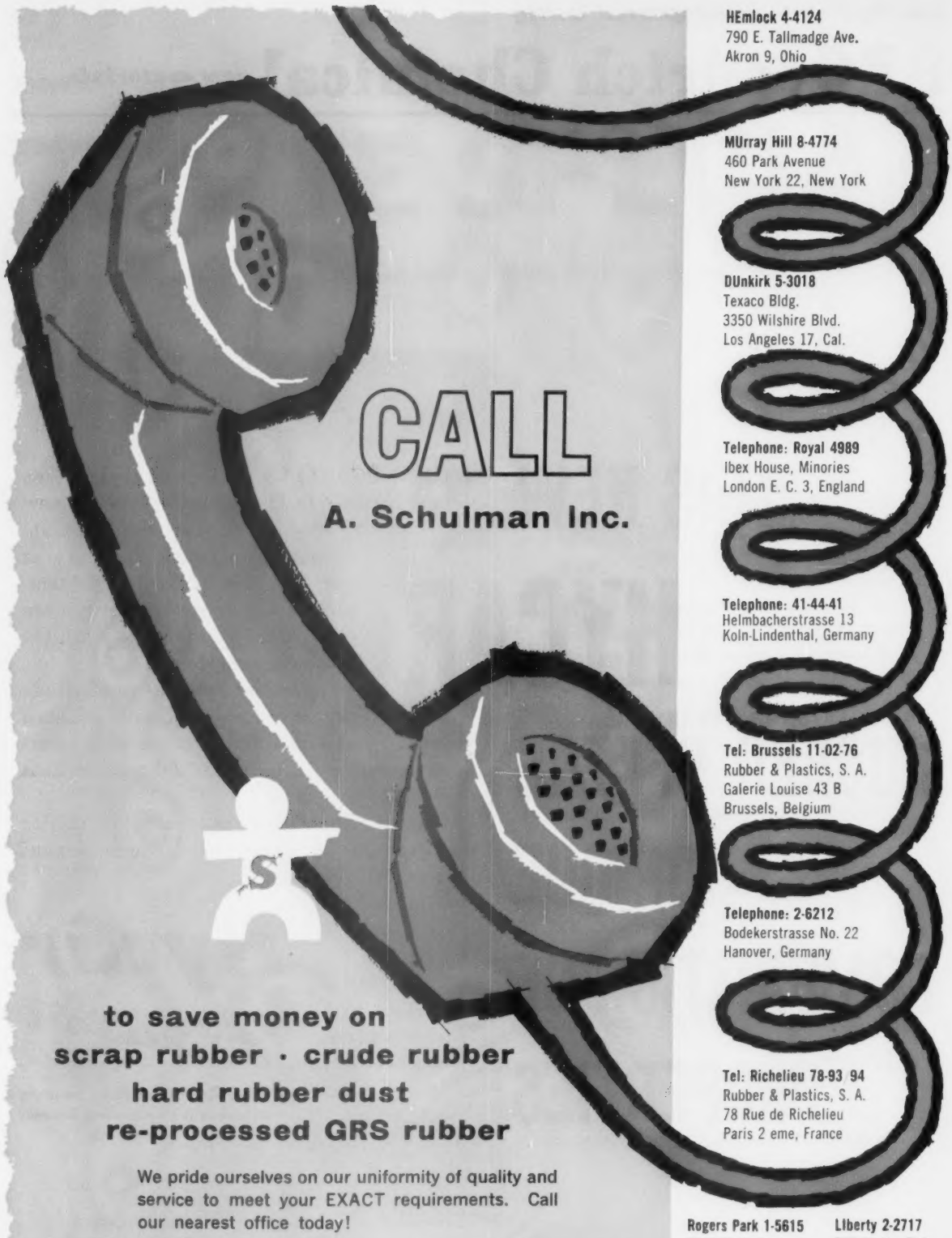

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In This Issue

1001 Compounding Light Colored Rolls—By Ralph F. Wolf and Robert R. Meltz

Rubber-covered rolls are used in the textile, food processing, metal and many other industries, each with its own special requirements. Achieving the proper physical properties is facilitated by this practical guide for rubber compounders.

1013 Compounding Elastomers for Rubber-to-Metal Adhesion—By William M. DeCrease

A bondability index has been evolved to designate elastomers for an application of great current interest. This research relied on a novel testing method which can measure small differences in bond strength with remarkable ease and accuracy.

1020 Swelling of Reinforced Elastomers in Boiling Water—By S. Palinchak and W. J. Mueller

Water absorption studies were conducted to help rubber technologists to equip steam and hot water systems. Data on polymers and fillers point to impurities as the major bottleneck.

1028 How Much Are They Costing You? A Special Industry Report on Problem Employees—By Auren Uris

A new approach to the "bad apples" that may have found their niche in your organization suggests that they can cause major losses—in terms of money and intangibles. You will find valuable tips on how to identify problem employees and deal with them at all levels.

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* Appears every other month

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Highlights Sidelights *of the News . . .*

September, 1960

Goodrich-Gulf Chemicals, Inc., has inaugurated an active program for granting licenses to manufacture synthetic-natural rubber (polyisoprene) to producers in the United States and Canada . . . Goodrich-Gulf will offer the licenses under its own patents together with sublicenses under the pertinent catalyst patents of Dr. Karl Ziegler (page 1031).

A 9 1/2-cent hourly wage increase plus extra allowances has been agreed upon by the "big four" and the United Rubber Workers . . . Over 75,000 employees are affected by the wage agreement (page 1044).

The Cuban plants of three rubber companies owned by U.S. interests have been seized by the Castro government . . . The three plants involved are owned by U.S. Rubber, Goodyear and Firestone . . . A Goodrich plant narrowly escaped confiscation because 80 per cent of the facility is held by a Mexican subsidiary (page 1031).

Firestone has announced plans to open four new plants in the next few months . . . The new plants will bring the company's total to 75 . . . One of the new plants will produce Coral and Diene synthetic rubbers (page 1052).

DuPont has officially opened its new $11 million neoprene plant at Londonderry, Northern Ireland . . . The plant has an annual operating capacity of 50,000,000 pounds of neoprene (page 1052).

The Natural Rubber Producers' Research Association held a two-day symposium on "Fundamentals of Failure Phenomena in Rubbers" on July 7 and 8 at its Welwyn Garden City Laboratories outside of London . . . Seven papers were presented at the symposium (page 1060).

Twenty-six papers are scheduled to be presented at the technical program at the annual meeting of the Rubber and Plastics Division of the American Society of Mechanical Engineers to be held on October 10 to 11 at the Hotel Lawrence in Erie, Penna. (page 1046).

Atlas Supply Co. of Newark, N. J., has entered into a license agreement with L. W. Tomarkin, inventor of the Tomarkin Process for increasing tire traction on wet, snowy and icy surfaces . . . Atlas is now licensing tire manufacturers to produce Tomarkin-treated tires (page 1037).

Major carbon black producers are setting up overseas manufacturing operations because the rubber industry abroad is expanding at a rate double that in the United States . . . By 1963 or 1964. foreign capacity should reach 1.2 billion pounds (page 1037).

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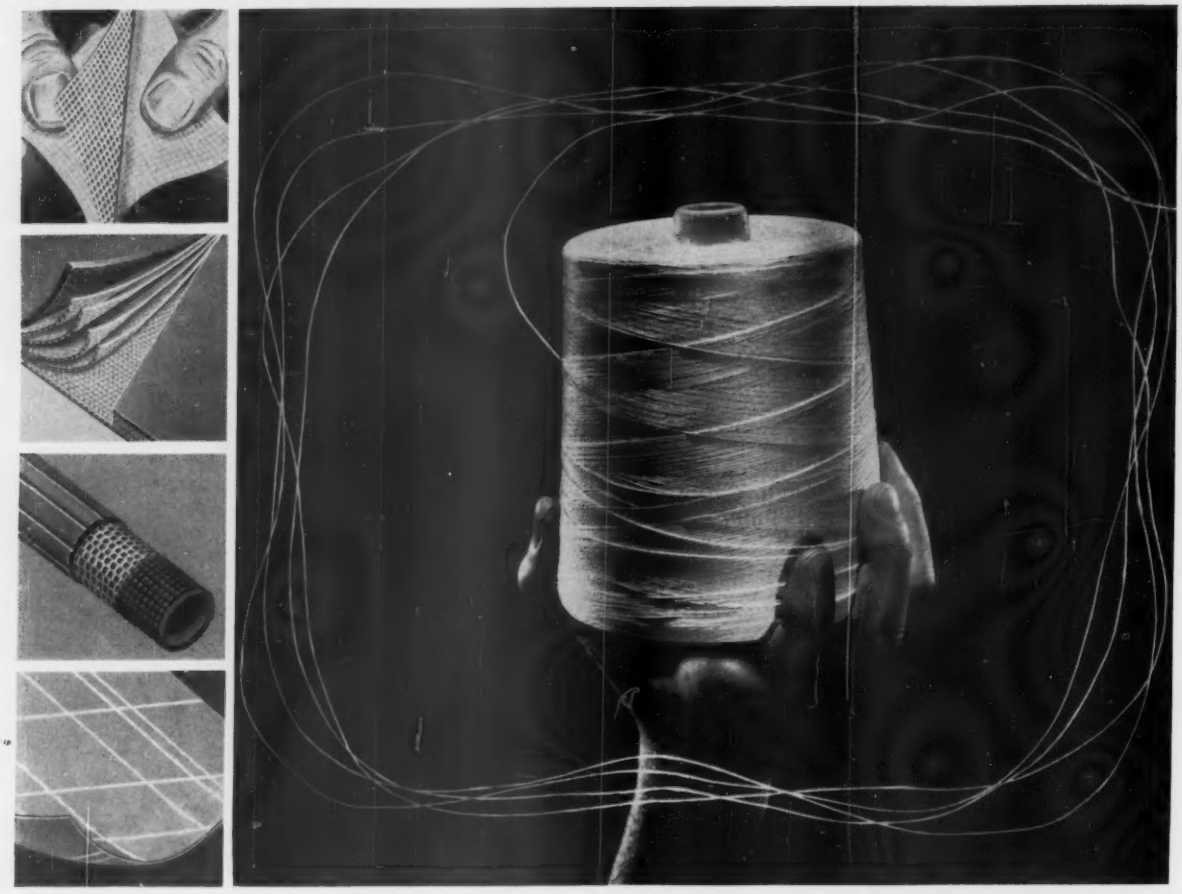

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• **Reclaimed Rubber in India.** The growing shortage of rubber in India has compelled the Central Government to expedite the production of reclaimed rubber. The Union Ministry of Commerce and Industry has so far approved three projects: one at Delhi, for an annual production of 1,000 tons; the second at Coimbatore for an equal quantity; and the third at Bombay, which is to have a capacity of 5,000 tons. Dunlop and Bata are already producing about 2,500 tons per year for their own consumption.

The Delhi plant will go on stream within the next few months. Negotiations for the Bombay plant project are being carried on with foreign investors at the present time; no definite steps have been taken regarding the Coimbatore plant. It is possible that the Government might authorize the building of a fourth factory at Calcutta because the demand for reclaimed rubber is expected to go up from 6,000 tons to 13,500 tons in 1965.

• **Second Synthetic Rubber Plant in India.** Hyderabad has been selected as the site of a projected synthetic rubber plant. The announcement was made by the leader of the Soviet Russian five-man delegation which is now touring India in connection with the Indo-Soviet agreement for the construction of industrial plants. The Soviet Union will supply all necessary equipment and technical know-how by the end of 1963. Details regarding the actual manufacturing process of the synthetic rubber will be known shortly.

• **Rubber Industry Conferences in Malaya.** Three major conferences will be held during the month of September in Malaya. The first wil be held in Singapore for packers and shippers of natural rubber and will deal with standards and quality of packing and related subjects. The International Rubber Study Group meeting, to be attended by delegates from 22 nations, will cover increasing natural rubber production, the position of natural latex, new uses for natural rubber and marketing problems, during the second week in Kuala Lumpur. A special group of research workers will discuss the problems of natural rubber and natural latex during a conference which will take place from September 26 to October 1 in Kuala Lumpur.

• **American Bon Mots in India.** The growing interests of the Indian trade press in American progress is manifested by many editorial pages dealing with developments here. Malaya, too, is following American publications very closely; the April issue of *The Planter,* the official magazine of the Malayan planters, published in Kuala Lumpur, contains a few tidbits. It has reprinted a job yardstick from the *New York Daily Mirror:* "It's strange how unimportant your job is when you're asking for a raise, and how important it can be when you want a day off."

Former President Harry Truman expressed it in the following way: "It's a recession when your neighbor loses his job; it's a depression when you lose yours."

One of the highlights of the selection is contributed by Cary Grant who said: "Alcohol is an excellent liquid for preserving almost everything but secrets."

• **Swedish Rubber Meeting.** The tenth anniversary of the Sveriges Gummitekniska Förenings was celebrated by a conference held in Saltsjöbaden a few months ago. Synthetic rubber was the main theme of the lectures. The first paper dealt with the effect of polymer gel content on the processing characteristics of SBR compounds. A description of the ways in which specialized needs may be satisfied by using SBR was the theme of the second paper.

A summary of the development of many kinds of polymeric materials was given by C. S. Pyne of the Goodyear International Corporation. "Blends of Neoprene and SBR" was the theme of the paper delivered by H. Horn of E. I. du Pont de Nemours, Switzerland, who itemized the different characteristics of the two polymers and described vulcanizing systems suitable for certain blends.

Dr. G. Kraus of Phillips Petroleum Co. delivered a lecture on the new rubber *cis*-4 polybutadiene, in which he explained that this product may be used to replace part of the natural rubber in such applications as truck tires, where heat build-up problems militate against the employment of SBR. Not only does *cis*-4 polybutadiene ho'd promise of being cheaper than natural rubber but its performance on the road is superior.

P. W. Cornell of the Goodrich-Gulf Co. dealt with another comparatively new synthetic rubber, *cis*-1,4-polyisoprene. Mr. Cornell described the ways in which the introduction of 3,4 configuration in the main 1,4 polymer is detrimental to certain properties. He concluded that less than 5 per cent of 3,4 configuration, high molecular weight and loose gel structure are the features necessary in polyisoprene in order to achieve the highest tensile and lowest heat build up.

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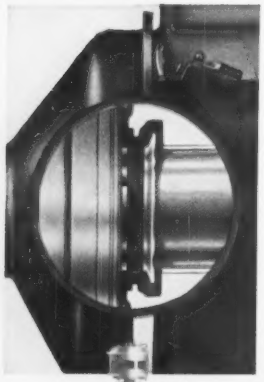

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Chemigum—T. M. The Goodyear Tire & Rubber Company, Akron, Ohio

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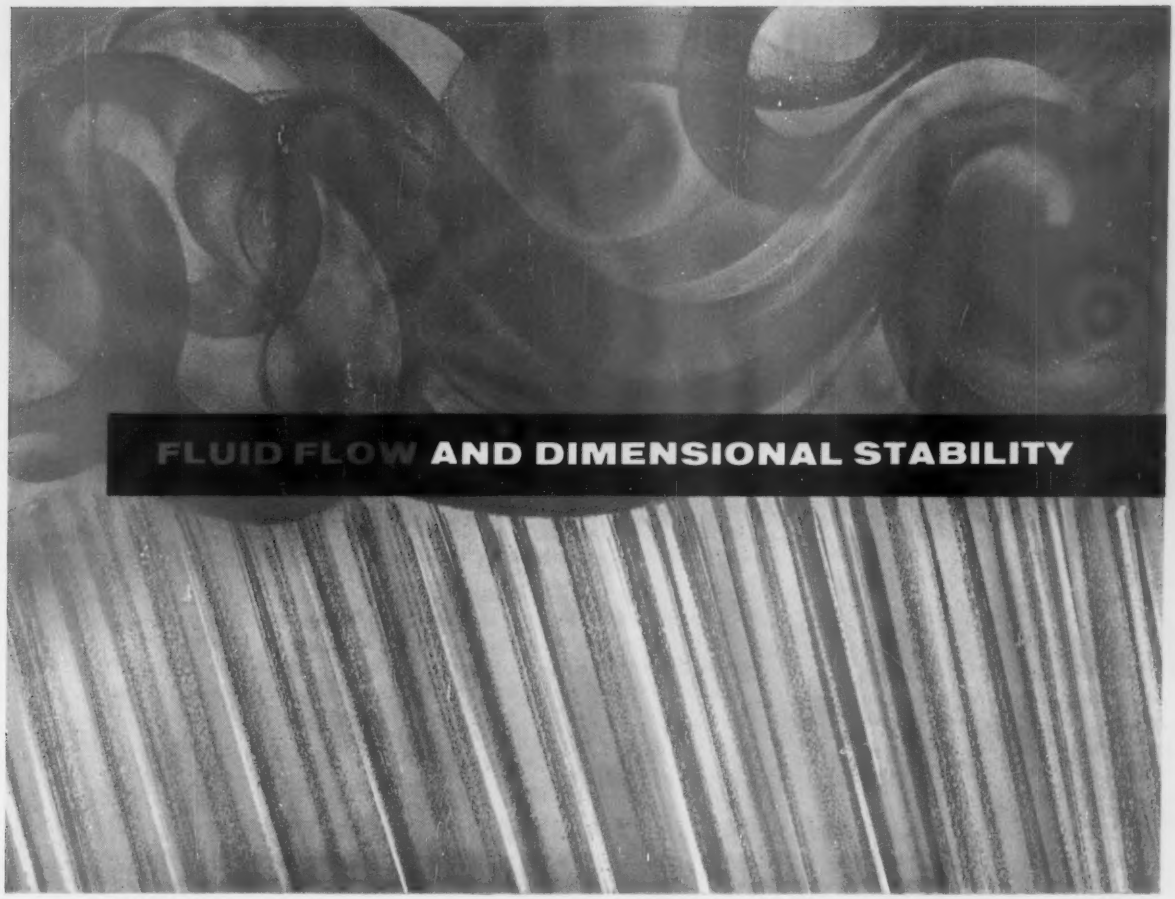

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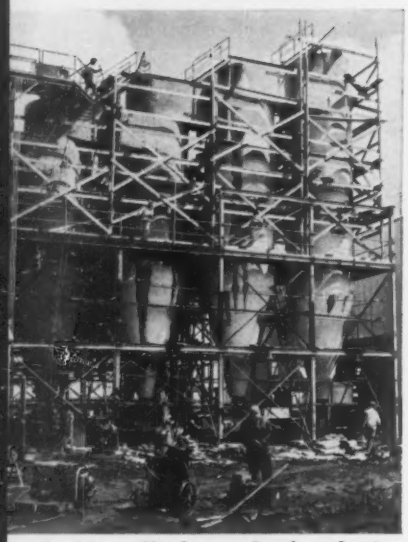
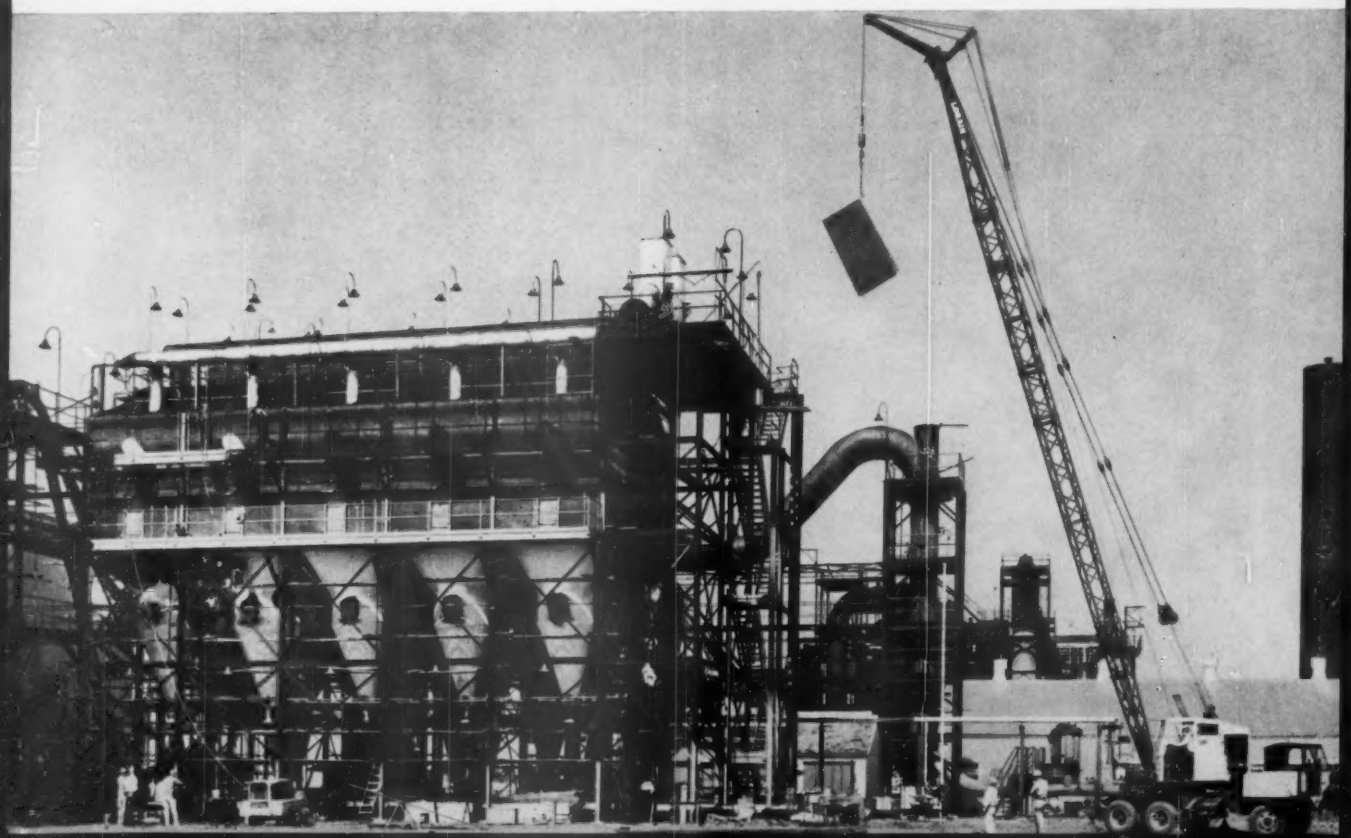


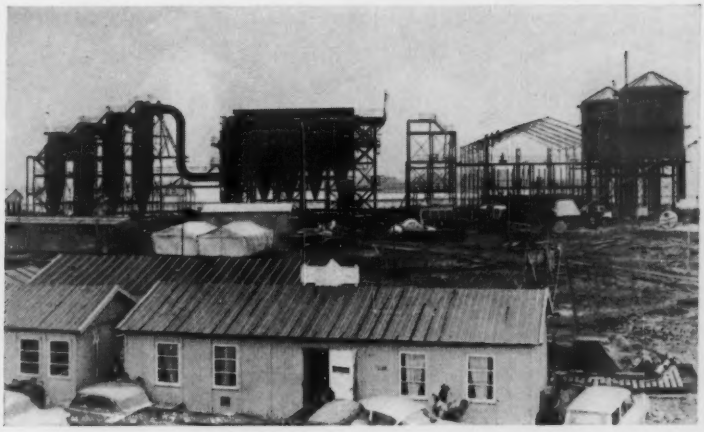
Louisiana: Newly completed production facilities for 25,000,000 lbs per year have just been brought on stream at Westlake to help meet the demand for premium quality carbon blacks.

The demand for quality carbon black by the rubber industry, both here and abroad, has reached a record-breaking level. And within the next few years, this demand is expected to increase even further. To keep pace with these carbon black requirements, Witco-Continental is engaged in a major expansion program to increase the Company's production capacity 50 per cent. New plants are being constructed in California, France and Italy, while a new plant in The Netherlands has now been completed. New additions also have recently been completed for present facilities in Oklahoma and Louisiana. Naturally, new laboratories are also being built to assure Witco-Continental customers the finest technical and other services.

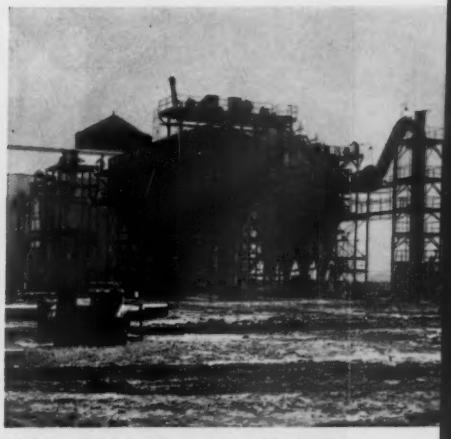
Oklahoma: The new facilities which were added to the Ponca City plant in 1959 increased production at this site by 25,000,000 lbs per year. This new addition has fully instrumented production controls as do all Witco-Continental plants.



CARBON BLACK DOLLAR at Witco-Continental



Europe: Steadily increasing demands for Witco-Continental carbon blacks have led the company to establish plants, laboratories, and sales offices on the Continent. A 30,000,000-lb-per-year plant has been completed at Rotterdam, The Netherlands. A 56,000,000-lb-per-year plant is under construction at Bordeaux, France, and a new 60,000,000-lb-per-year plant is under construction in Trecate, Italy.



California: The first carbon black plant ever to be built on the West Coast will be constructed by Witco-Continental. Located at Bakersfield, California, it will produce 30,000,000 lbs of oil furnace grade blacks per year. This photograph of the new oil furnace addition at Ponca City, Oklahoma is similar to the plant being constructed in California.

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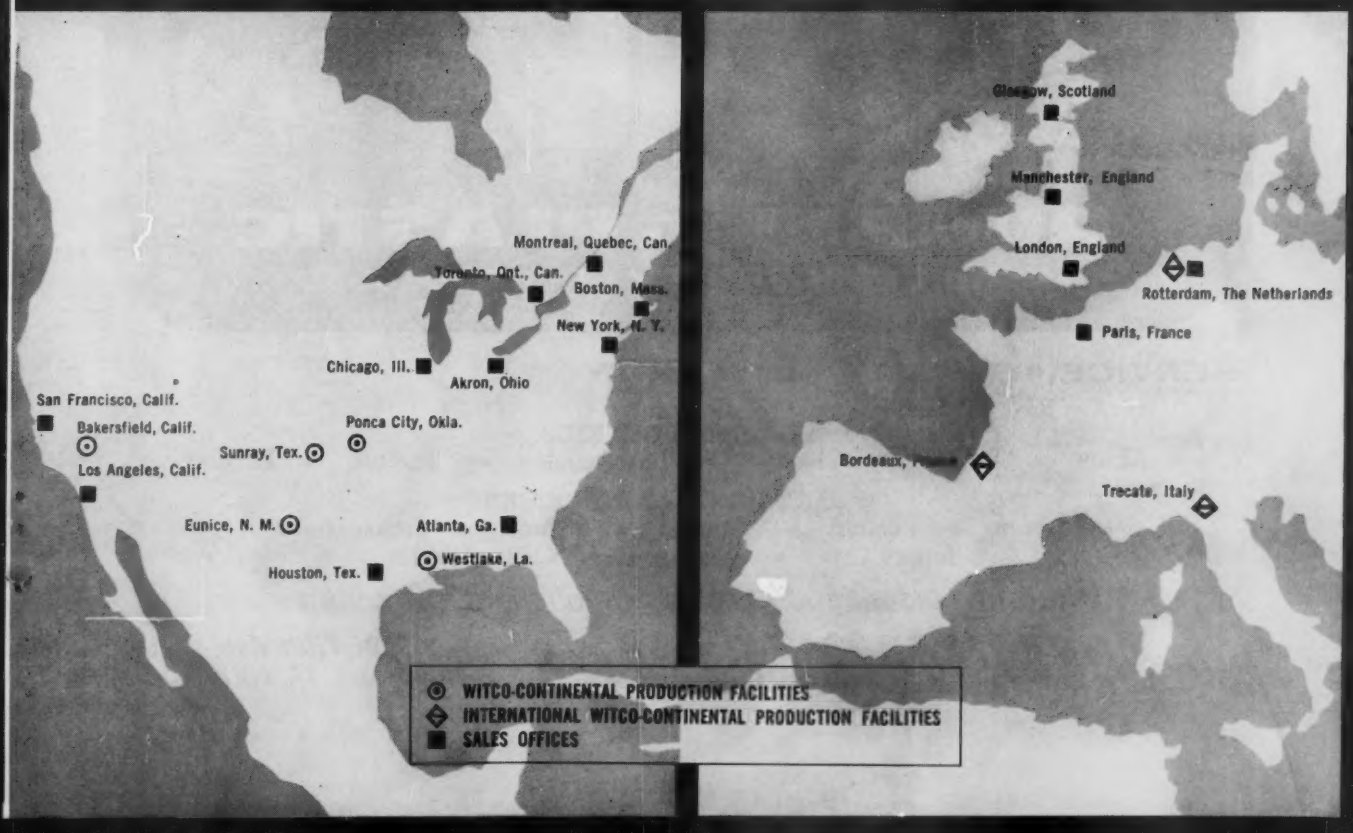

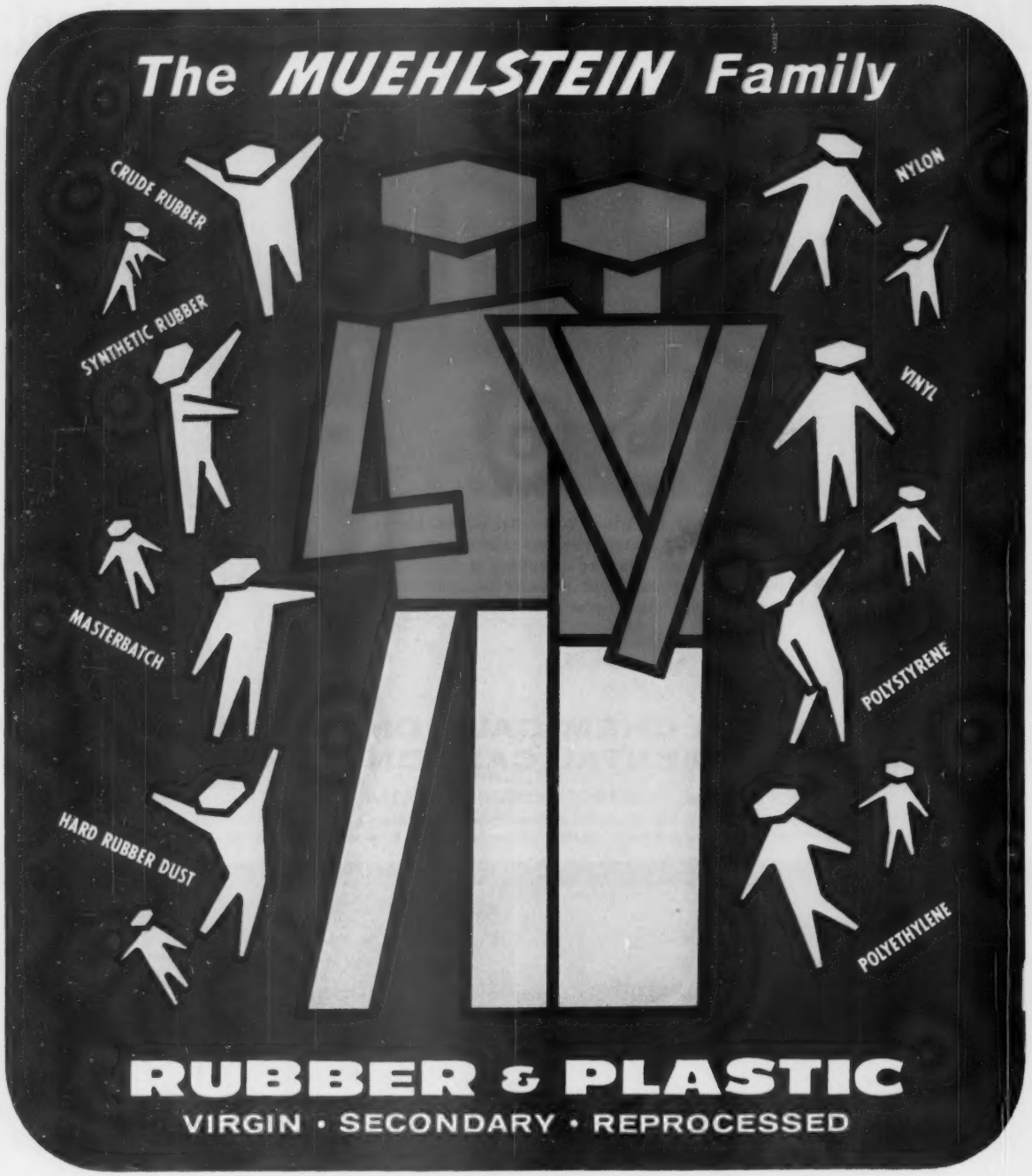

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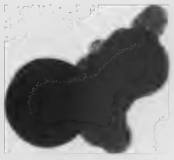

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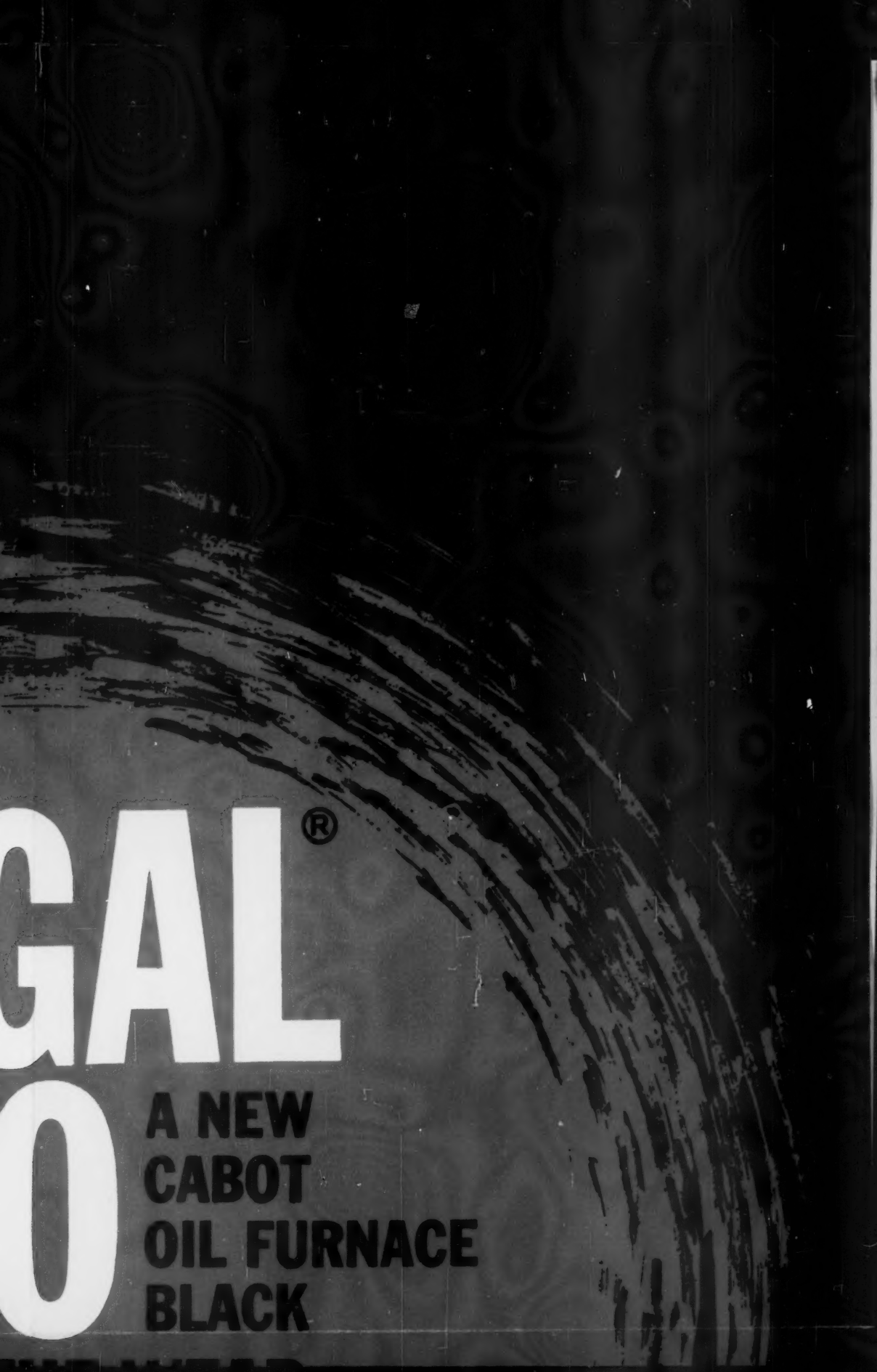

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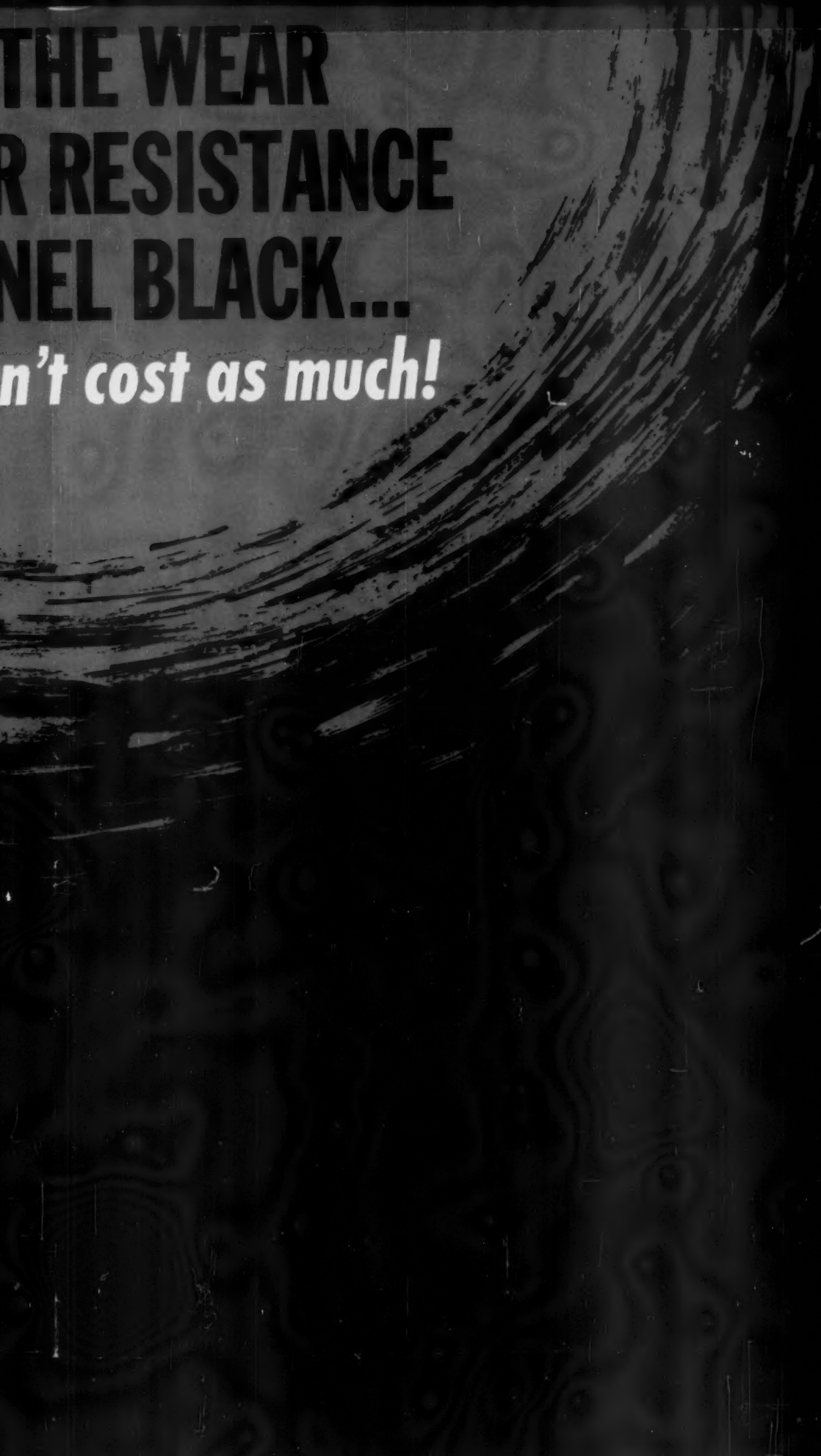

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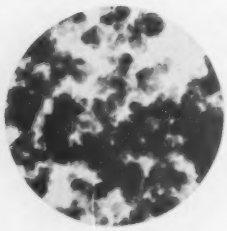

REGAL 300 provides rubber properties virtually identical with those of premium-priced channel blacks, but with the faster curing rate of HAF types. It is comparable with EPC black in modulus, elongation and tensile strength. Regal 300 is recommended for use in highway and off-the-road truck treads, and tread rubber, where service calls for typical channel black resistance to tearing, cutting and chipping.

REGAL 300 is one of an entirely new family of oil furnace blacks from Cabot, including Regal 600, a totally new type of oil furnace black, and Regal SRF, the first semi-reinforcing black to be made from oil. These new blacks are now in commercial production and available worldwide, another step in Cabot's long-range program to meet threatened gas shortages and rising natural gas prices.

For free samples and complete technical information on Regal 300, Regal 600, and Regal SRF, write:

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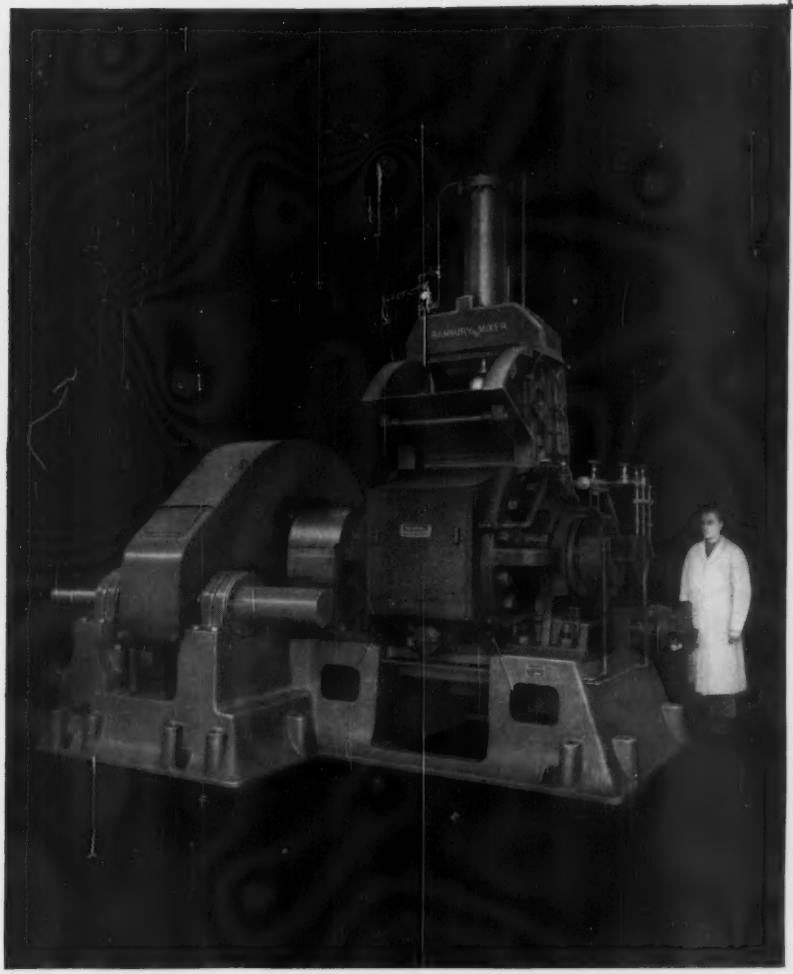

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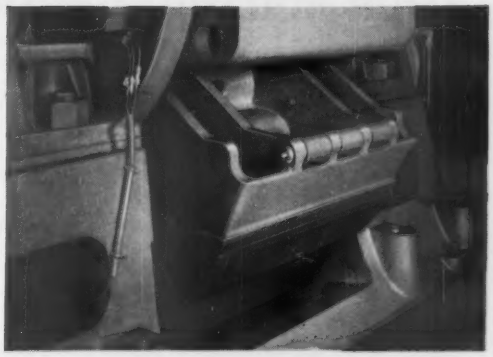

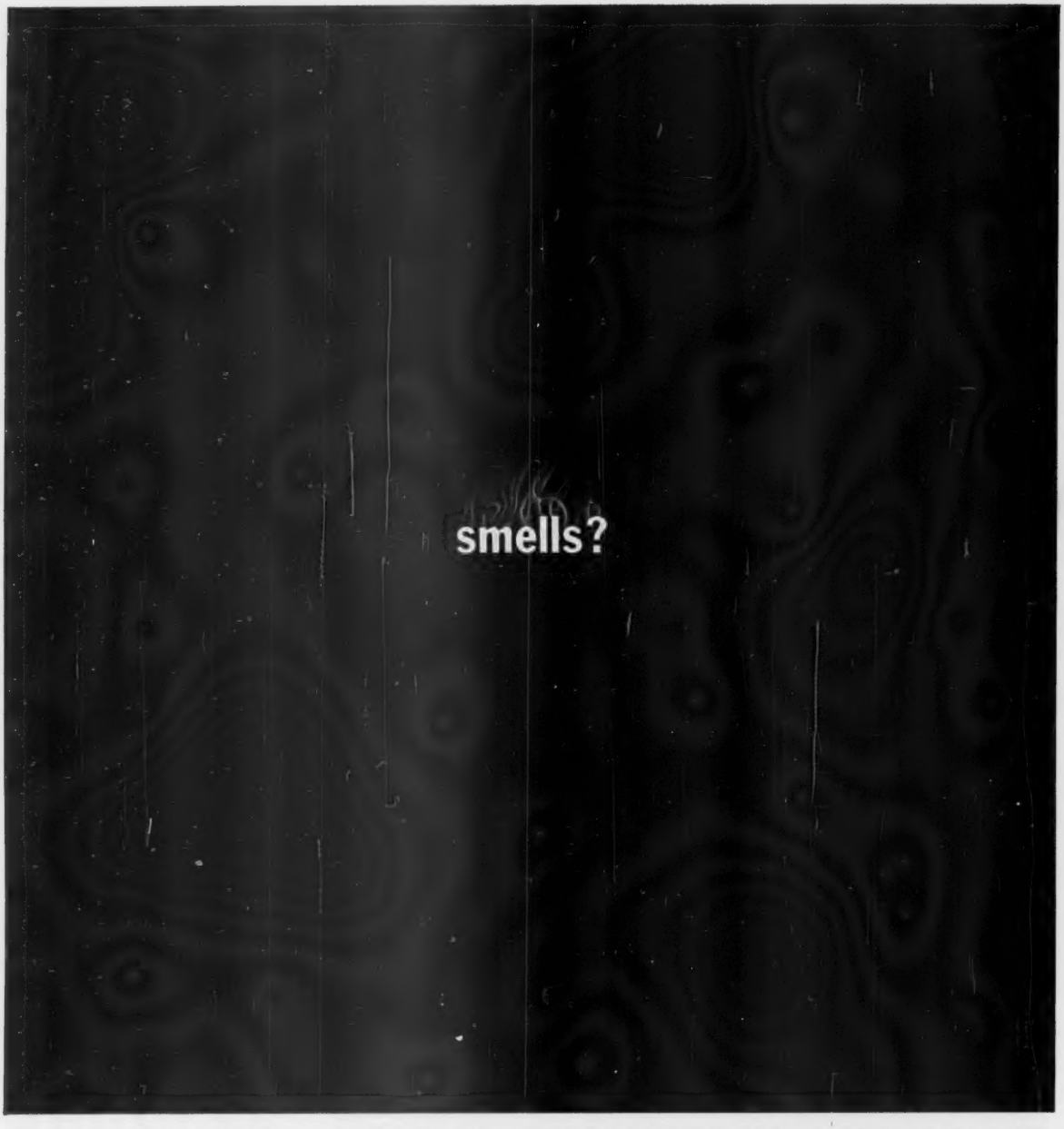

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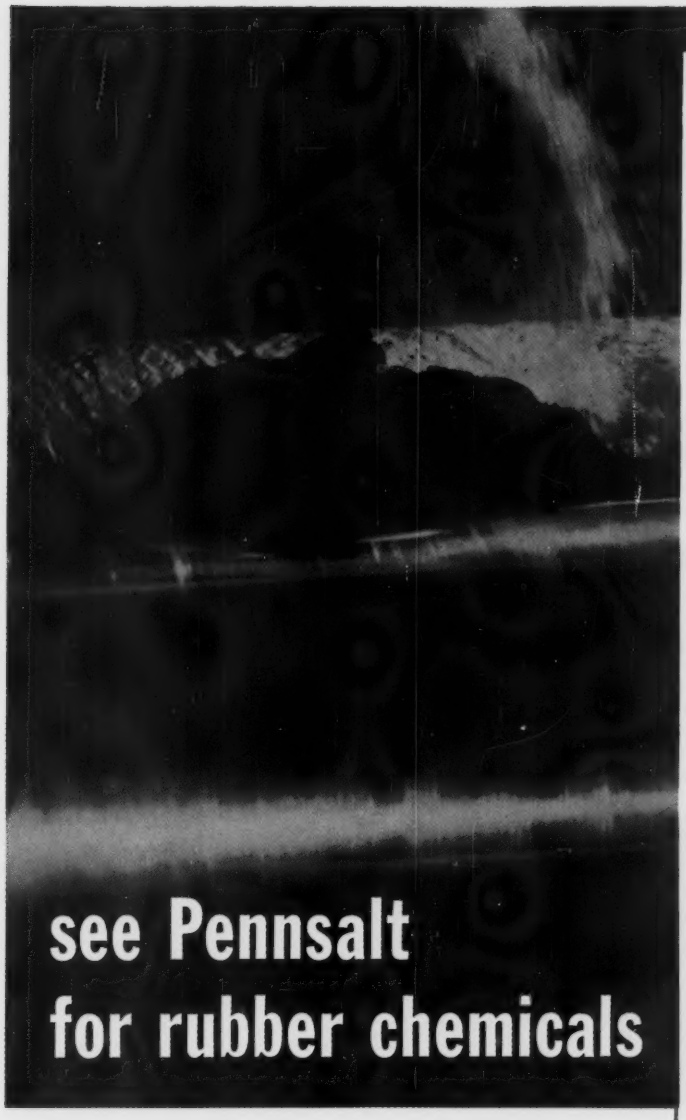

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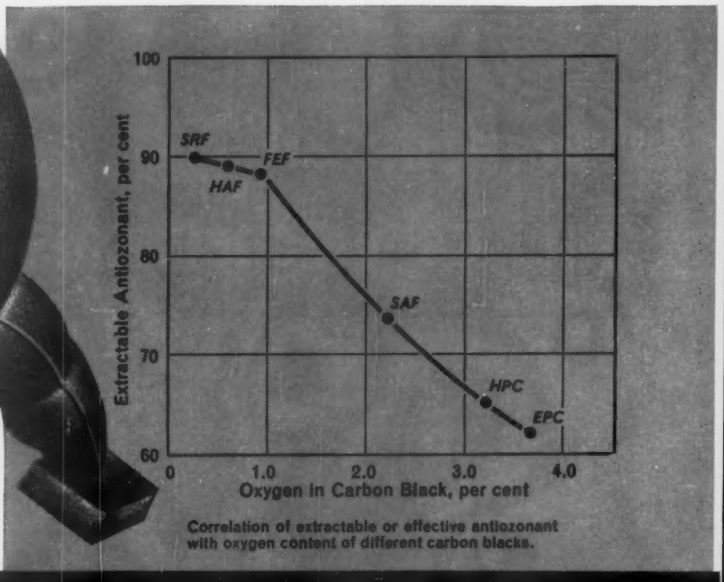
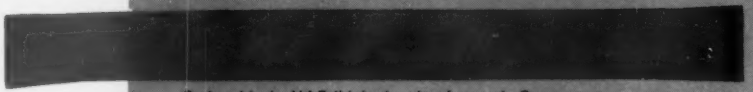
what type of CARBON BLACK helps fight ozone attack?



Correlation of extractable or effective antiozonant with oxygen content of different carbon blacks.

The SBR specimens at right were exposed to ozone at 100° F, 20 percent elongation, 52 hr. at 33 pphm ozone, then 187 hr. at 63 pphm ozone.

Carbon black—EPC (easy processing channel), Curing system—2 phr sulfur, 2 phr benzothiazyl disulfide, Hours to first crack—31 to 47.



Carbon black—HAF (high abrasion furnace), Curing system—2 phr sulfur, 2 phr benzothiazyl disulfide, No cracks in 238 hr.

the kind you choose can be a help or a hindrance . . .

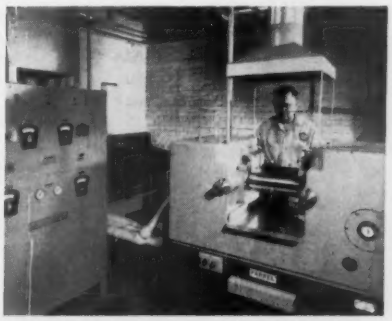
Are you aware of the extent to which some carbon blacks adversely affect the protection afforded rubber products by antiozonants?

Some inactivate much of the antiozonant added for ozone protection. Others are more compatible with the antiozonant. How this affects the ozone resistance and hence the service life of rubber is well illustrated by the chart and table below. Even more dramatic than the figures presented is the difference in condition of the two rubber test strips shown at lower left.

Here is clear evidence that carbon black plays an extremely important part in obtaining maximum service life of rubber compounded with antiozonants.

In formulating rubber compounds which must have high resistance to ozone, look to Universal for assistance. Special facilities and technical personnel are available to serve you. Write or telephone our Products Department.

To cover all phases of service conditions, UOP rubber labs conduct dynamic and static tests both indoors and outdoors:



To evaluate any service problem, test formulations are carefully compounded in this rubber mill by trained UOP technicians.

DeMattia flexer is used to evaluate flex-cracking properties of compounds tested in UOP rubber laboratory.

Test specimens mounted on outdoor racks are examined at regular intervals for evidence of deterioration.

CARBON BLACK TYPE AND ANTIOZONANT EFFECTIVENESS

Carbon Black	Approximate Areas, sq m per g	pH	Per Cent Oxygen in Black	Per Cent UOP 88 Extractable from Vulcanizate	Hours to First Crack of Vulcanizate 100 F—50 pphm Ozone		
					Elongations		
					25 Per Cent	20 Per Cent	15 Per Cent
None...	...	...	...	97.1	>336	>336	>336
MT.....	7	7.4	...	92.2	>336	>336	>336
FT.....	18	7.2	...	91.6	>336	>336	>336
SRF....	20	9.4	0.37	89.9	>336	>336	>336
HAF....	70	9.2	0.71	88.6	>336	>336	>336
FEF.....	40	9.3	0.97	87.9	>336	>336	>336
ISAF...	100	9.1	...	80.6	>336	>336	>336
SAF....	~140	...	2.21	74.5	>336	>336	>336
HPC...	~160	4.0	3.25	64.8	3	6	16
EPC...	110	4.3	3.71	61.9	2	2	6

The table above shows how carbon black type affects extractable antiozonant, which in turn affects ozone resistance of rubber. Note that rubber stocks containing a low percentage of oxygen show high extractable antiozonant, and consequent long life under conditions of high ozone concentration and stress.

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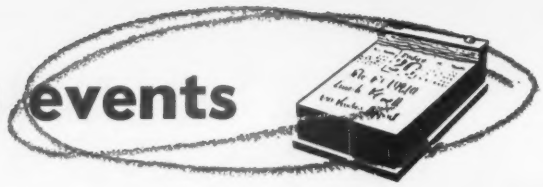

Sept. 13-15. American Chemical Society, New York Section, Chemical Exhibition, Hotel Statler, New York, N. Y.

Sept. 14-16. Division of Rubber Chemistry, American Chemical Society, Fall Meeting, Hotel Commodore, New York, N. Y.

Sept. 15-16. American Society of Mechanical Engineers, Engineering Management Conference, Morrison Hotel, Chicago, Ill.

Sept. 15-16. Armed Forces Chemical Association, 15th Annual Meeting, Sheraton-Park Hotel, Washington, D. C.

Sept. 18-21. American Society of Mechanical Engineers, Petroleum Mechanical Engineering Conference, Jung Hotel, New Orleans, La.

Sept. 19-23. International Rubber Study Group, 15th Meeting, Kuala Lumpur, Malaya.

Sept. 21-23. Society of the Chemical Industry, Plastics and Polymer Group Symposium, London, England.

Sept. 22. Fort Wayne Rubber & Plastics Group, Technical Meeting, Van Orman Hotel, Fort Wayne, Ind.

Sept. 22-23. Chemical Market Research Association, Fall Meeting, Wentworth-by-the-Sea, Portsmouth, N. H.

Sept. 22-Oct. 30. Chemical Equipment Exposition, Busto Arsizio, Italy.

Sept. 25-28. American Institute of Chemical Engineers, Mayo Hotel, Tulsa, Okla.

Sept. 26-28. Standards Engineers Society, 9th National Convention, Pittsburgh-Hilton Hotel, Pittsburgh, Penna.

Sept. 26-30. Instrument Society of America, 15th Annual Meeting, International Instrument - Automation Conference and Exhibit, New York Coliseum, New York, N. Y.

Sept. 26-30. Third Canadian National Material Handling Show and Conference, Show Mart, Montreal, Quebec, Canada.

Sept. 26-Oct. 1. International Conference on Natural Rubber Research, Kuala Lumpur, Malaya.

Sept. 27-28. National Cotton Council, 9th Chemical Finishing Conference, Statler Hotel, Washington, D. C.

Sept. 29. Southern Ohio Rubber Group, Fall Meeting, Engineers Club, Dayton, Ohio.

Sept. 30. Akron Rubber Group, 2nd Annual Dance, Sheraton Hotel, Akron, Ohio.

Sept. 30. Ontario Rubber Group, Golf Tournament, Dundas Valley Golf & Curling Club, Dundas, Ontario, Canada.

Sept. 30. Rubber Chemical Salesmen's Association of Akron, University Club, Akron, Ohio.

Oct. 3-5. Canadian Association for Applied Spectroscopy, 7th Ottawa Symposium, Ottawa, Ontario, Canada.

Oct. 4. Los Angeles Rubber Group, Technical Meeting, Biltmore Hotel, Los Angeles, Calif.

October 4-7. International Rubber Conference, West Berlin, Germany.

Oct. 4-7. Tenth Annual Instrument Symposium and Research Equipment Exhibit, National Institute of Health, Bethesda, Md.

Oct. 6-7. National Association of Corrosion Engineers, 10th Annual Western Region Conference, Sheraton-Palace Hotel, San Francisco, Calif.

Oct. 6-8. National Association of Corrosion Engineers, Southeast Region Conference, Dinkler-Plaza Hotel, Atlanta, Ga.

Oct. 7. Chicago Rubber Group, Technical Meeting, Furniture Club, Chicago, Ill.

Oct. 7. Detroit Rubber & Plastics Group, Fall Meeting, Detroit Leland Hotel, Detroit, Mich.

Oct. 7. Philadelphia Rubber Group, Technical Meeting, Poor Richard Club, Philadelphia, Penna.

Oct. 7-8. Southern Rubber Group, Fall Meeting, Roosevelt Hotel, New Orleans, La.

Oct. 10-11. American Society of Mechanical Engineers, Rubber and Plastics Division Conference, Lawrence Hotel, Erie, Penna.

Oct. 11. Buffalo Rubber Group, Fall Meeting, Continental Inn Hotel, Buffalo, N. Y.

Oct. 11-14. National Association of Corrosion Engineers, Northeast Region Conference, Prichard Hotel, Huntington, West Va.

Oct. 11-13. Second International Synthetic Rubber Symposium, Church House, Westminster, London, England.

Oct. 12-14. Fourth Conference on Analytical Chemistry in Nuclear Reactor Technology and First Conference on Nuclear Reactor Chemistry, Gatlinburg, Tenn.

Oct. 12-23. Automobile Manufacturers Association, 1960 National Automobile Show, Cobo Hall, Detroit, Mich.

Oct. 13. Northern California Rubber Group, Past Presidents' Night, Elks Club, Berkeley, Calif.

Oct. 13-14. Society of the Plastics Industry, 16th Annual New England Section Conference, Wentworth-by-the-Sea, Portsmouth, N. H.

Oct. 14. Boston Rubber Group, Fall Meeting, Somerset Hotel, Boston, Mass.

Oct. 14-15. American Society for Quality Control, 15th Midwest Conference, Broadview Hotel, Wichita, Kansas.

Oct. 14-23. International Materials Handling Fair, Paris, France.

Oct. 17-19. Electrical Insulation Conference, Sponsored by the National Academy of Sciences-National Research Council, Mayflower Hotel, Washington, D. C.

Oct. 17-19. International Congress on Technology of Plastics Processing & International Plastics Exhibition, Amsterdam, The Netherlands.

Oct. 17-21. Forty-Eighth National Safety Congress and Exposition, Conrad Hilton Hotel, Chicago, Ill.

Oct. 18. Commercial Chemical Development Association and Chemical Economics Division, Chemical Institute of Canada, Joint Meeting, Queen Elizabeth Hotel, Montreal, Quebec, Canada.

Oct. 18-21. American Society for Testing Materials, Committee D-13 on Textile Materials, Fall Meeting, Sheraton-Atlantic Hotel, New York, N. Y.

Oct. 19-20. National Association of Corrosion Engineers, North Central Region Conference, Schroeder Hotel, Milwaukee, Wisc.

Oct. 19-26. International Instrumentation and Automation Fair, "Interkama," Duesseldorf, West Germany.

Oct. 19-26. Second International Plastics Fair, Macroplastics, Utrecht, The Netherlands.

Oct. 21. New York Rubber Group, Fall Meeting, Henry Hudson Hotel, New York, N. Y.

Oct. 23-27. National Shoe Fair, Palmer House, Chicago, Ill.

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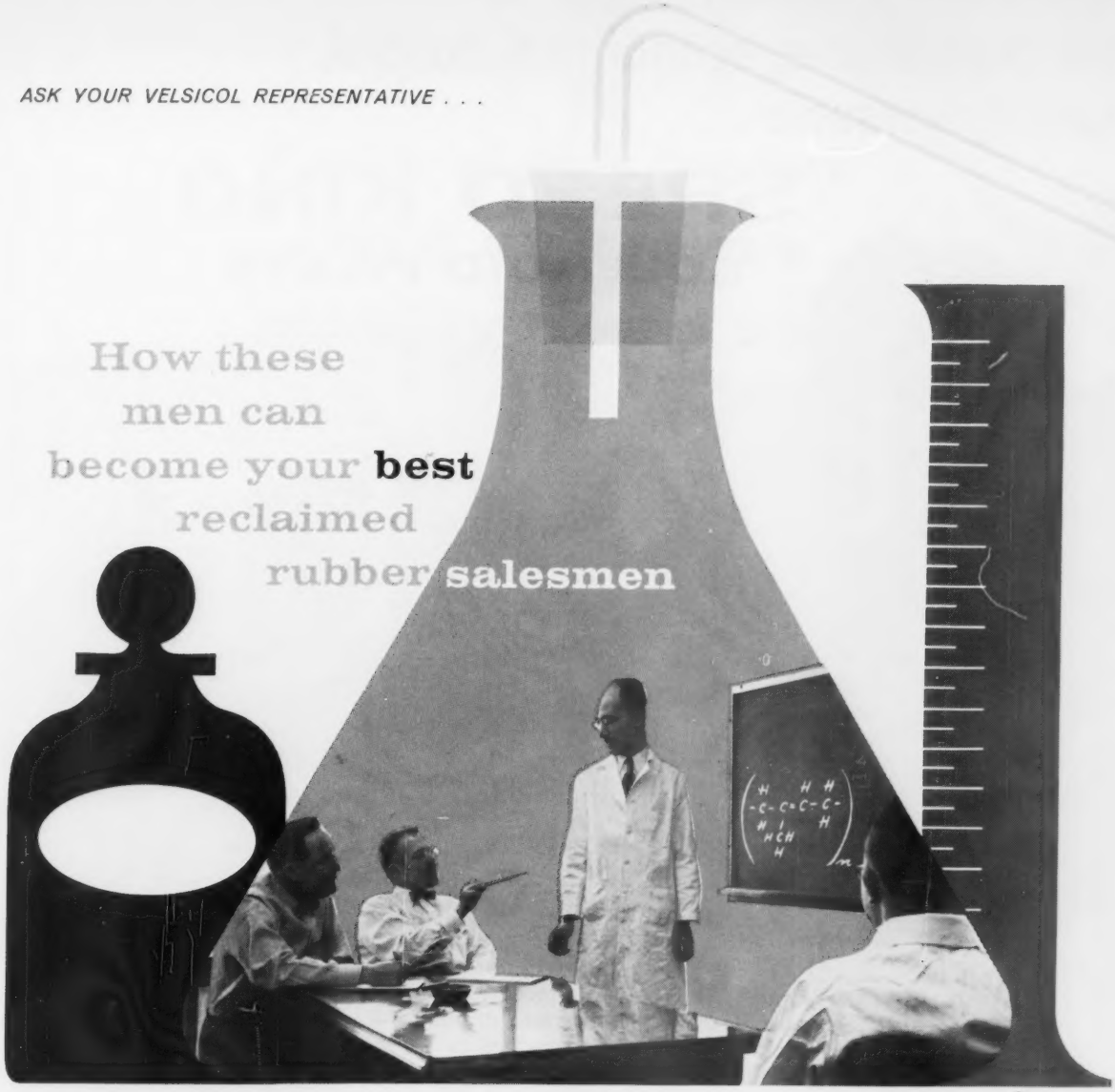

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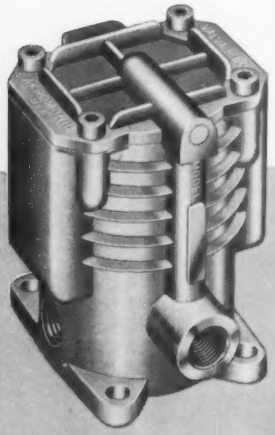

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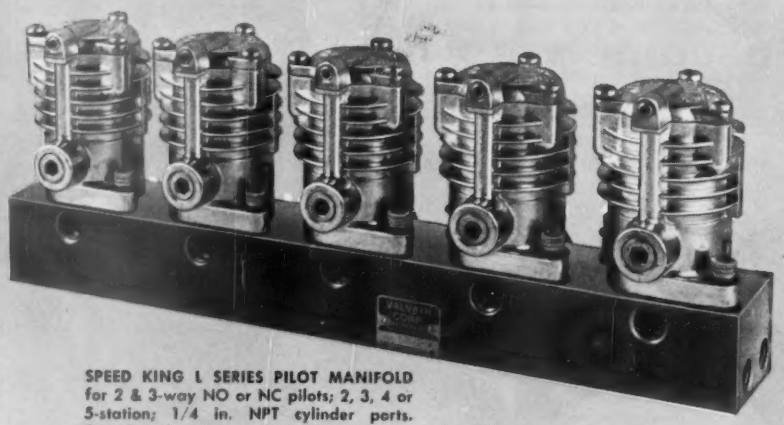
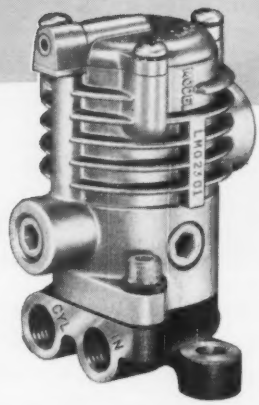


SPEED KING L SERIES PILOT MANIFOLD for 2 & 3-way NO or NC pilots; 2, 3, 4 or 5-station; 1/4 in. NPT cylinder ports. 5-station shown.



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Phillips technical sales service provides in-plant assistance on everyday production problems, keeps you advised of new processing techniques.

Phillips quality control of Philprene polymers helps you reduce shut-downs on the production line, lets you market uniformly high quality products.

Phillips technical information keeps you abreast of new ideas in the rubber field.

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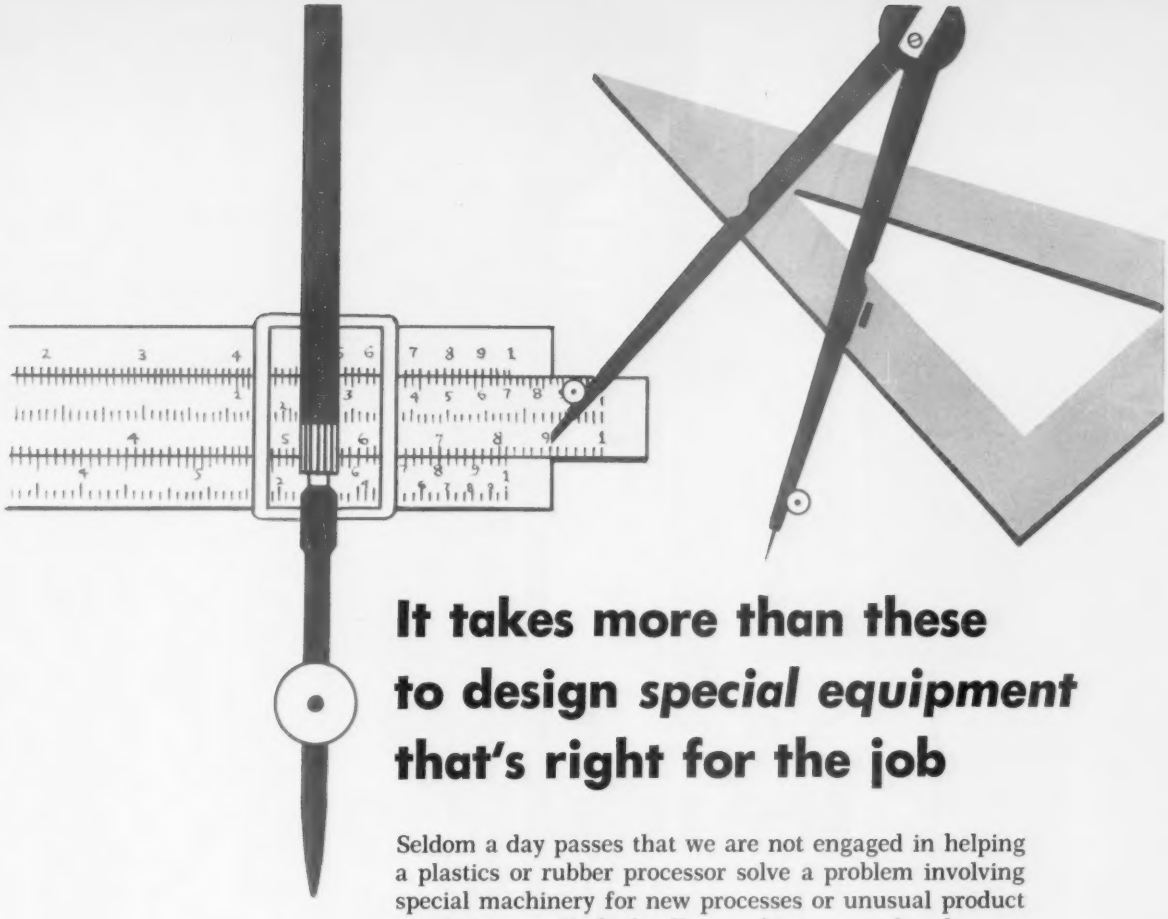

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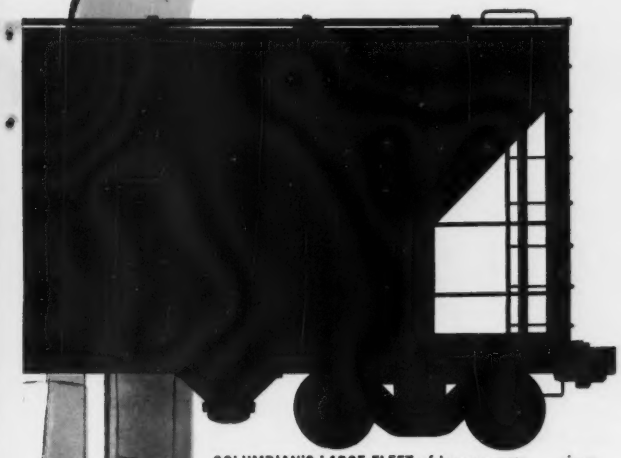

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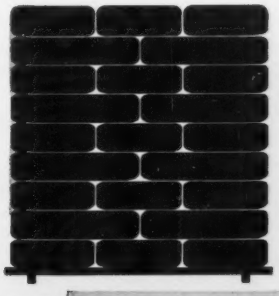

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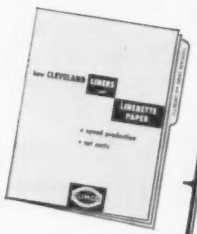

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is an excellent powdered processing resin which exhibits remarkable non-staining properties in white rubber compounds

Listed below are the results of ultraviolet exposure tests on seven white SBR compounds. Each compound contains a different resin to the extent of 20% on the RHC and all are leading resins used in the processing of light colored rubber compounds. The reflectance readings listed are based on a scale of 0 to 100; 0 being complete absorption and 100 maximum reflectance. Tests were performed by an independent laboratory*.

Sample Code	*Before Exposure*	*After Exposure*
PETROLEUM BASE RESIN	86	75-81
POLYMEL DX 111 NS	100	80
COMPETITIVE RESIN #4	83	39-41
COMPETITIVE RESIN #2	88	75
COUMARONE-INDENE (MED.)	69	62-64
COMPETITIVE RESIN #5	96	73
COMPETITIVE RESIN #6	86	40-42

**name upon request*

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14¼¢ per lb. in lots of 5000 lbs or over

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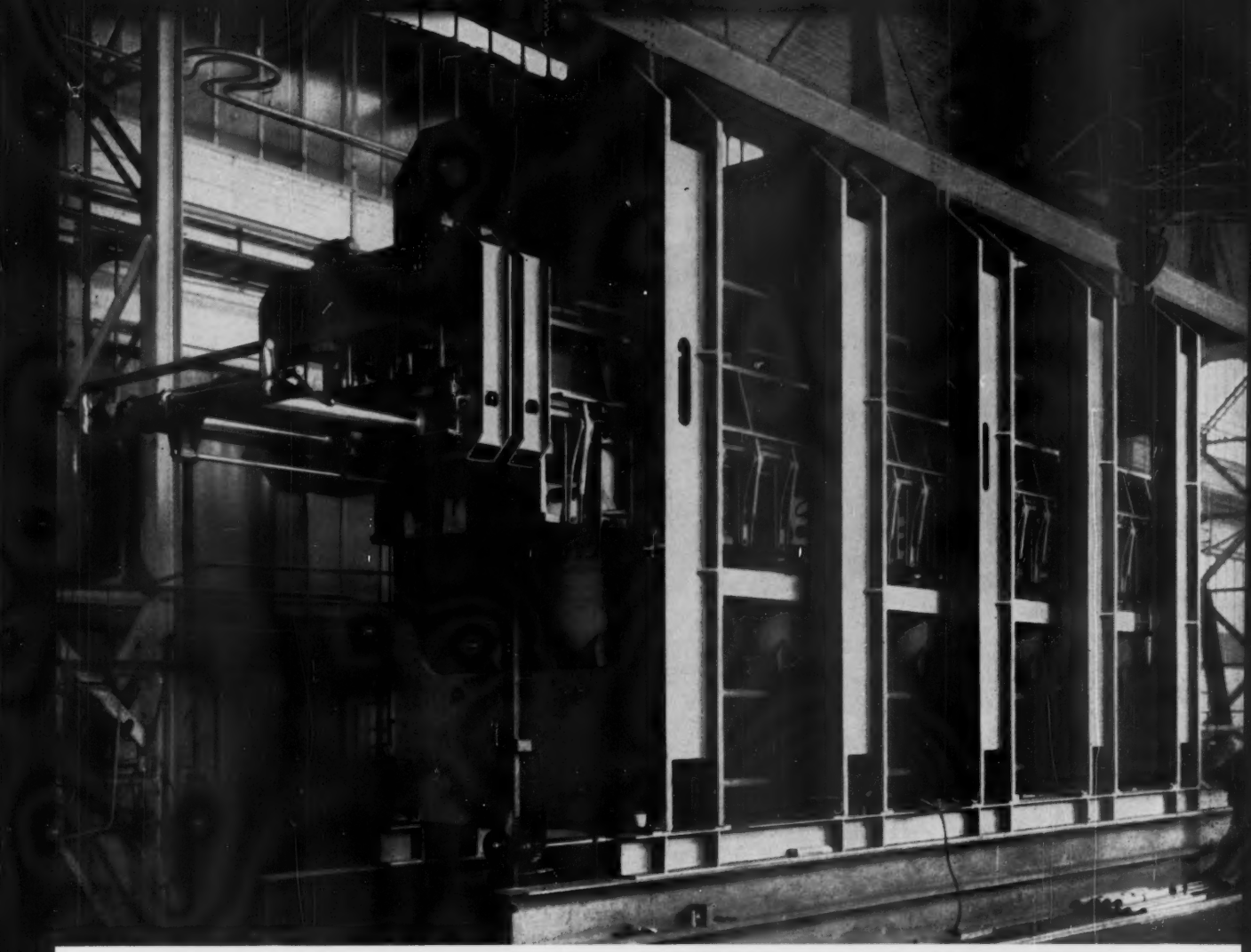

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UNITED® ENGINEERING AND FOUNDRY COMPANY

PITTSBURGH, PENNSYLVANIA

As Ken Soule Sees It

by Kenneth J. Soule

Fish Story

Chemical and Engineering News, (July 25, 1960) carried a news item and several interesting pictures concerning a fish-saving project being carried out in our Far West. The fish involved are salmon and steelhead fingerlings which have been spawned upstream of Brownlee Dam on the Snake River, in the rugged mountainous border between Idaho and Oregon.

Under ordinary circumstances the young fish would have to battle through many rapids and falls, as well as man-made hazards on their long journey down the Snake, into the Columbia, and thence to the Pacific Ocean. Now, however, to guard the fingerlings from the perils of passage through the turbines and spillways incidental to the elaborate dams and reservoirs on the Snake River, the Idaho Power Co. has put in operation a new fish collecting, sorting and delivery system.

By means of a fine-mesh barrier net 120 feet deep and 2,800 feet long, the down-stream travelers are routed through 3,250 feet of 8-inch flexible rubber pipe to aerated and refrigerated trucks, which give them a free ride of some fifteen miles downstream. Here, well below these dams and powerhouses, the well-rested fish are returned to the river to continue their seaward journey. Until we receive direct evidence to the contrary, we shall assume that the salmon involved are happy about this new arrangement and do not consider it an infringement of their personal liberties.

The pipe in question was manufactured by the Manhattan Rubber Division of Raybestos-Manhattan. It is known as Condor Flexible Rubber Pipe.

Russian Leadership

One pastime which has achieved much popularity in this country in the last few years is that of comparing Russian and U.S. strength and potentials, particularly in the fields of science and scientific achievements.

When politicians pose as experts along these lines, facts are rarely allowed to impede the orator in his (or her) search for some spectacular phrase, or some compelling argument to prove that the political opposition has done everything the worst possible way. Americans in general understand this aspect of office-seeking, and take much of this exaggerated talk with considerable amounts of salt. Readers and listeners abroad, however, are often confused and amazed by the vitriolic nature of some of the claims made. And as a matter of fact, when the "politicking" gets to the point where it gives aid and comfort to the enemy (as quite a few recent diatribes seem to) even American voters begin to wonder.

Although political strategists lead the list of those comparing the U.S. unfavorably with Soviet Russia, a considerable number of journalists, columnists, commentators, etc., also indulge in the practice. Some of this serves to gain attention by an eye-catching headline or a provocative expression, whether factual or not. Others go off on a tangent inadvertently.

Progress in Automation

In the latter class are the recent newspaper reports regarding Soviet progress in automation—following the First Congress of International Federation of Automatic Control, held in Moscow in July, 1960, attended by 150 Americans. Statements by our lay press at the time claimed that Western scientists were, "amazed and shattered" at Soviet devices for automation and control.

Actually, such a statement is far from the truth, according to Dr. Robert A. Brand, manager of market development in the process control program of I.B.M.'s Advanced Systems Development Division. Dr. Brand's complaint is that any remarks made by Americans attending the conference, regarding Soviet achievements in automation, were taken out of context. No comparisons were really made concerning what has been done in this country, but only with what the Russians themselves may have accomplished under the conditions existing in their own country.

Dr. Brand further goes on to state that as far as commercial equipment and industrial development (in computation and automation) are concerned the U.S.S.R. lags far behind the U.S. Another small but most interesting item mentioned by Dr. Brand in the question and answer interview reported in *C & E N* (August 1, 1960), is the fact that "the Russian stores, even the big ones—are without—cash registers, and where you expect to see a cash register, you see—an abacus!"

What is It?

Just to refresh your memory, an abacus is a very ancient and quite primitive counting device. It consists of a wooden frame crossed by several single wires, each carrying a number of different colored wooden beads. In appearance it looks like a child's toy, and while it still finds use in certain countries in teaching kindergarten mathematics, it seems incredible that it could be used industrially except—in the direst emergency. . . . However, if, as Dr. Brand reports, it is the standard means of expediting the receipts of monies and the making of change in stores throughout the U.S.S.R., there *must* be some good Russian reason for it—no matter how weird the practice may appear to Western eyes.

Nevertheless, from here on in, the "Made in Moscow" claims of Muscovite superiority in everything (or in anything), will be even more suspect than heretofore, if possible. Consciously or not we shall be hearing the Commissar of Business Practices soothingly saying—

"There, there, little supermarkets,
Don't you cry
You shall all have two-stage abacuses
Bye and Bye!". . .

ROCKS ON THE RUN – In the making by The Port of New York Authority, the second traffic level on one of the world's most beautiful bridges, the graceful George Washington Bridge that joins the Jersey shore to Manhattan Island. The end result . . . beauty pointed skyward, begins with down-to-earth digging, upheaval of earth, removal of rocks, change of terrain. Contractors George M. Brewster & Co., Inc., responsible for a tremendous amount of the work being done on the New Jersey approach to the new level, estimated removal of approximately four hundred thousand yards of rock and one hundred fifty thousand yards of dirt on their contracts alone. New approaches to the bridge had to be cut from huge solid rock cliffs. Much of this rock was processed for re-use on the job as stone backfill, and as concrete aggregate. Thirty-six-inch belts were used to convey the rock from processing plants to hoppers. The belts for this huge operation were made for George M. Brewster & Co., Inc. by Hewitt-Robins, the carcasses of which were made with Mount Vernon fabrics.

This is another example of how fabrics made by Mount Vernon Mills, Inc., and the industries they serve, are serving America. Mount Vernon engineers and its laboratory facilities are available to help you in the development of any new fabric or in the application of those already available.

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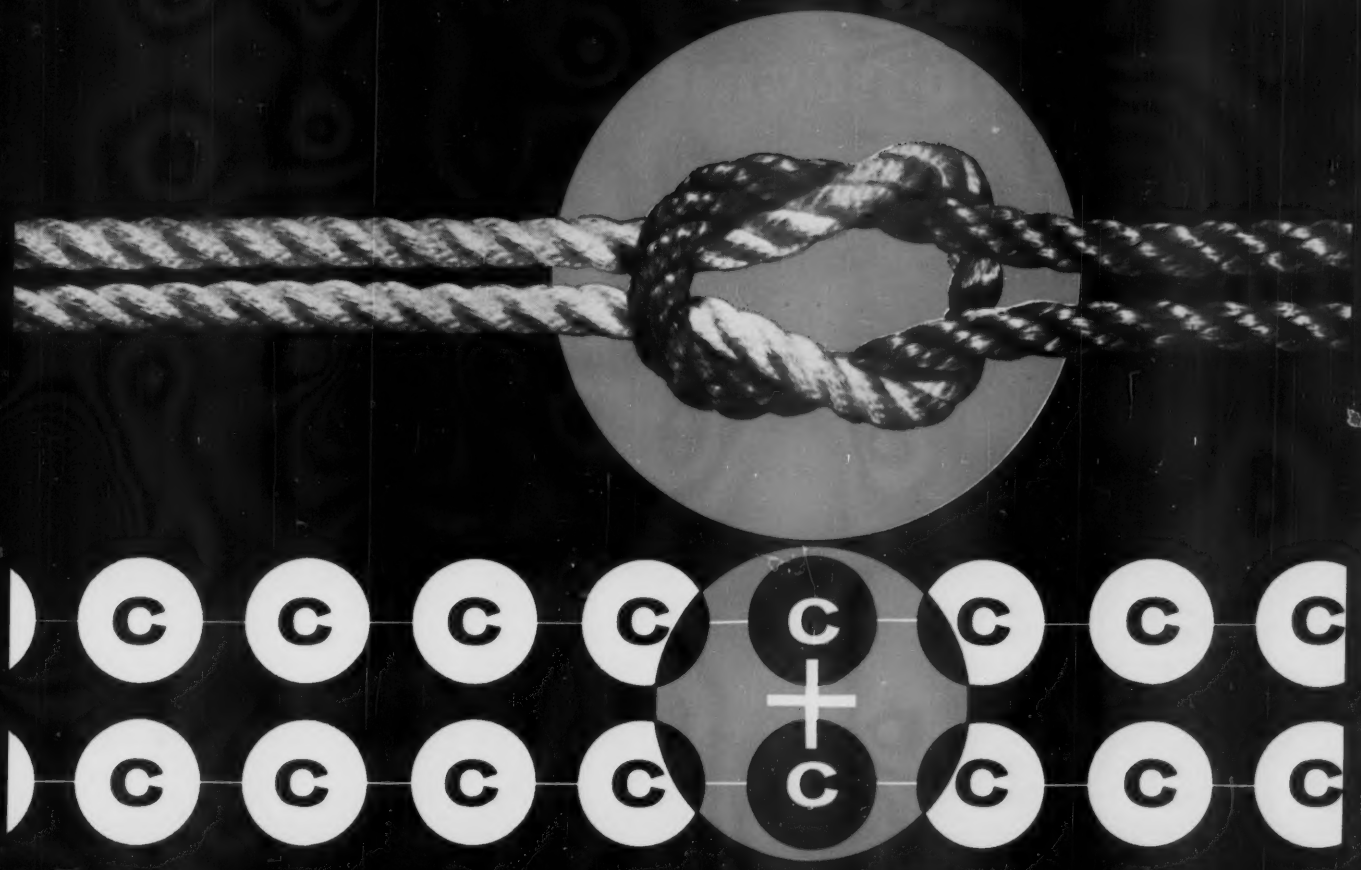

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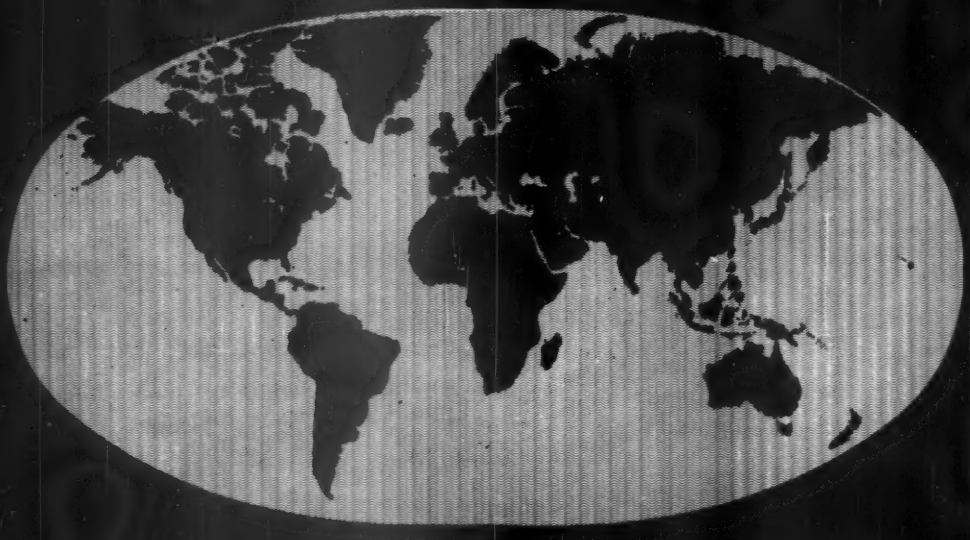

Since 1940, a total of 74 predip and calendar lines for rayon and nylon tire cord fabric production have been designed and built by C. A. Litzler engineers for leading tire manufacturers throughout the world. In addition to these prime production installations located in 32 countries around the globe, 22 Computreaters — precision laboratory impregnation lines introduced in 1957 — have been built for worldwide customers.

All of these production units are in profitable operation today, and a substantial number of them represent repeat orders based on outstanding performance of an initial unit or line.

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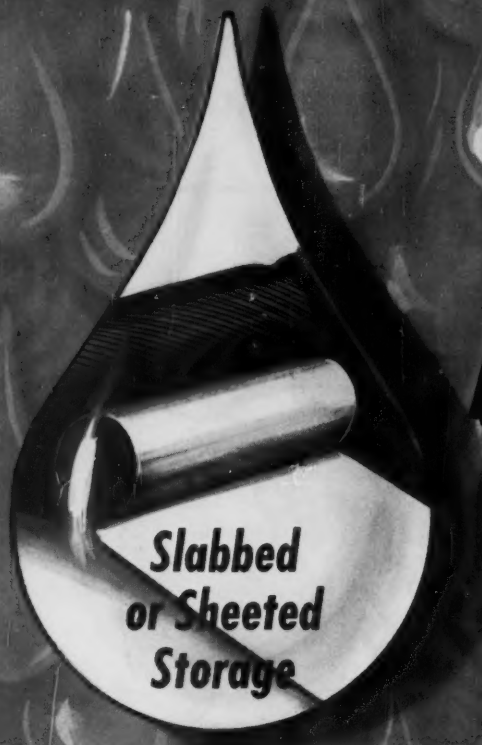

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You won't be able to see it on the rubber but you will know of its presence because of the non-adhesive properties it imparts. Does not interfere with tack or knit of stock.
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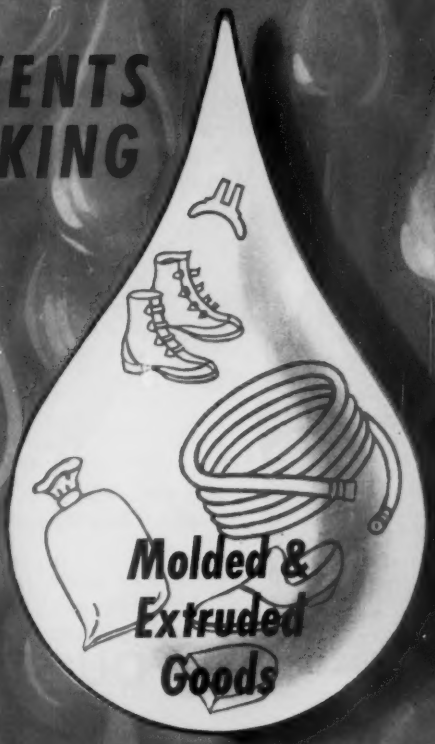

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In the major leagues, every game is played with a new home plate made of rubber. Inner soles of rubber help protect players' feet; elasticized bandages steady aching joints; rubber adhesives keep scrapes clean. From the insulation on the electric wiring that gives the game its night life, to the core of the baseball itself, rubber products play an important part in our national pastime.

Shell Chemical supplies manufacturers with much of the synthetic rubber that goes into sporting equipment —and many more products besides.

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capitol cues

THIS FALL'S CAMPAIGNS WILL PROBABLY QUICKEN THE TEMPO of business. That's Washington's feeling these days, now that the conventions are over. Government economists think that the electioneering will stimulate business until the voting in November. Thereafter, things may begin to ease a bit.

The optimism of the candidates is expected to be contagious. Businessmen and government officials will tend to act to keep business activity high--ordering more and spending more. So, jobs and sales will rise a bit more than usual. Thereafter, there may be a period of uncertainty--a pause no matter who wins. An easing in Winter might coincide with the appearance of other weaknesses and help bring on a recession next year.

THE NEXT PRESIDENT WILL ENLARGE THE GOVERNMENT'S ROLE--no matter who he turns out to be. Both parties have adopted platforms calling for bigger defense and welfare programs. And the word in Washington is that both of the candidates mean to live up to the platform promises. This means Nixon would veer away from Eisenhower's policies. GOP strategists concede their platform is something like the Democrats'. But they note vital differences.

-Similarities include the emphasis on economic growth and stepped-up programs for education, old-age medical care, aid to depressed areas, and medical research. The GOP has also promised to increase minimum wages and unemployment payments.

-Differences are equally significant. Republicans would not go for easy credit. On taxes, they would stress changes to encourage investment; Democrats talk more of curbing expense accounts and plugging loopholes. On labor, the GOP position is to oppose liberalizing the Taft and Landrum-Griffin Acts.

So, while both parties will move in the direction of bigger, bolder programs, there'll be important differences of degree.

THE TREND IN CORPORATE PROFITS SIGNALS SERIOUS PROBLEMS ahead for a great many firms. During the second quarter, earnings were about 13% below the rate in the same period of last year. Significantly, though, sales were actually up a little. So the squeeze on profit margins reflects increased costs of all kinds--wages and services like transportation, for example. What's more, recent productivity gains have not been as large as in 1959.

-The biggest declines from the second quarter of 1959 came in construction materials (down 20%), automobile equipment (25%), machinery (27%), metal products (30%), the railroads (45%), and iron and steel (a whopping 52%). Auto profits were off 9%. In rubber, they fell 1%. And in drugs, they dipped 8%.

-What earnings increases occurred centered in office equipment (up 20%), finance and oil (15% each), utilities (9%), paper (4%), food and tobacco (4%), and nonrail transportation (2%).

capitol cues (cont'd)

PRODUCTIVITY ISN'T RISING QUITE AS FAST these days as it did in 1959. That is one big reason why corporate profits aren't doing as well as hoped. Last year, the rise in output per manhour was very large in nonfarm lines--about 4.2% to 4.4%, according to the government's Bureau of Labor Statistics. The reasons: Efficiency always goes up during the first year of a recovery. For 1960, though, Labor experts say they expect to see gains of 3.3% to 3.5%. Why? Because in an upturn's second year, cost-cutting drives generally wane. Business starts hiring more nonproduction help--clerical...research...sales.

NEXT BIG LABOR NEGOTIATIONS will come in electrical manufacturing in October, when five-year contracts with General Electric and Westinghouse expire. All signs point to a rough fight, with management standing firm. The Electrical Workers want some 15 changes--all allegedly noninflationary--including fringes and wage increases of 3½%. But both firms will oppose big pay increases. And they want to kill cost-of-living escalator clauses. With the economy weakening, management will offer little and make it stick.

THIS WILL BE A BIG CROP YEAR FOR FARMERS, rivaling the record of '58. That's the word now coming from officials at the Department of Agriculture. Plantings were high and, recently, the weather has turned highly favorable. As a result, farmers' net income will be somewhat better than it was in 1959. (In 1959, low market prices brought farmers' net down to about $11 billion.)

Here is the latest official estimate for the major farm crops:
-Cotton: The 1960 crop will exeed 1959's 14.5 million bales.
-Wheat: Latest estimates are for 1.4 billion bushels--up 23%.
-Corn: A crop of 4¼ billion bushels is seen--only 2% below peak.
And early targets are being raised for other grains and soybeans.

CURRENT DECLINES IN THE BIRTH RATE will have a big impact on business if they continue for a prolonged period of time, say U.S. population experts. The rate is down 4% from a year ago. It has been falling for nine months now. One reason may be the small proportion of women in the high fertility bracket--20 to 30 years old. This could partly reflect low births during the Thirties. Another factor may be that parents are now deciding against larger families.

The rate may go up again soon, however. The experts are still reluctant to assign any real significance to the recent trend. But, they concede that if the downturn continues, it could be a depressing influence on sales of baby foods, furniture, and clothing. It would also curb building of schools and other public works. The Golden Sixties might be a lot less golden.

THE BUSINESSMEN'S BOOKSHELF--new U.S. booklets you may want to get. They are all available for little or nothing from various federal agencies.

-A new federal purchasing directory, to help small firms get U.S. business, is now available. The cost is 60¢ per copy from the Government Printing Office, Washington 25, D.C.

-Small manufacturers' aids--tips on management and how to handle government relations--are collected in a new booklet by the Small Business Administration. It costs 30¢. Write SBA in Washington for "Management Aids for Manufacturers."

Ameripol Rubber plays undercover role for Spalding

At the core of each Spalding-made Major League baseball is a "cushioned cork center" covered with a quarter-inch layer of Ameripol Rubber.

More important than the amount of rubber used are the rigid requirements for constant quality. The center must be perfect in every way, with uniform resilience from ball to ball.

Indicative of Spalding's quality control is the fact that balls are wound in a sealed room where temperature and humidity are held uniform at all times. This all helps insure that each ball meets Official Major League specifications.

If high quality is important in *your* rubber products, check with Goodrich-Gulf. From production research and quality control, to technical service and warehousing, we're organized to meet your needs. For information contact Goodrich-Gulf Chemicals, Inc., 1717 East Ninth Street, Cleveland 14, Ohio.

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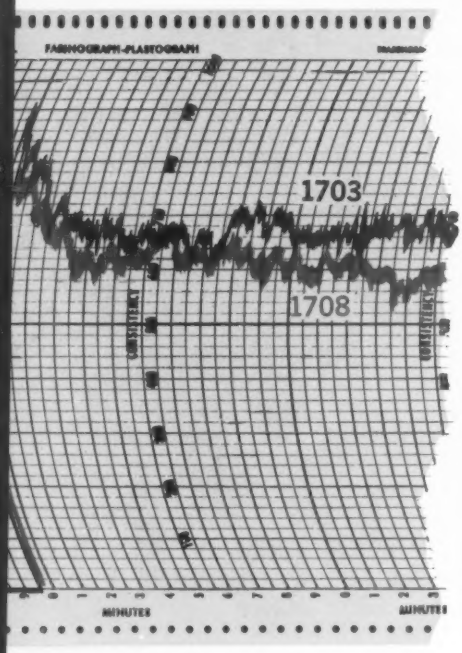
Can you make this 7% COST REDUCTION?

If you are now using a low-oil SBR for molded and extruded goods you can cut costs by switching to Ameripol 1708 (37½ part oil). Tests show physical properties compare favorably, color excellent, processability improved.



HIGHER-OIL
AMERIPOL
1708
EASIER TO PROCESS
Plastograph Comparison

One of the most widely used oil-extended SBR rubbers is 1703. Thus this polymer was selected as a "control" in laboratory tests to determine the advisability of switching to lower-cost Ameripol 1708, a higher-oil-level counterpart of 1703, in typical compounds. Comparative tests show that you can switch to Ameripol 1708 and obtain much the same physicals (improved in some respects). The tests were made in Goodrich-Gulf's Sales Service Laboratory on a typical low cost mat compound. The data here may help guide you to a substantial cost reduction. Ask your Goodrich-Gulf sales representative for complete information.

RECIPES USED FOR COMPARISON OF 1708 AND 1703

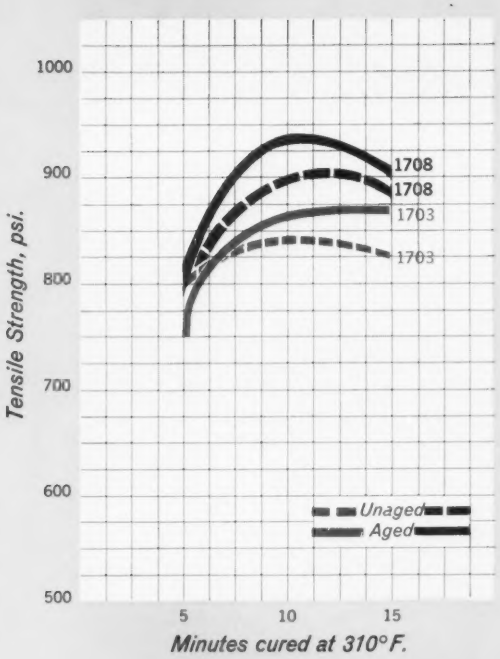
The two polymers 1703 and 1708 were substituted for each other, part for part, in the typical low cost mat recipe given below. All other ingredients were held constant.

The compounded stocks were tested for Mooney scorch at 280°F and the cured compounds (5, 10 and 15 min. at 310°F for tensile, elongation, 100% and 200% modulus and hardness.

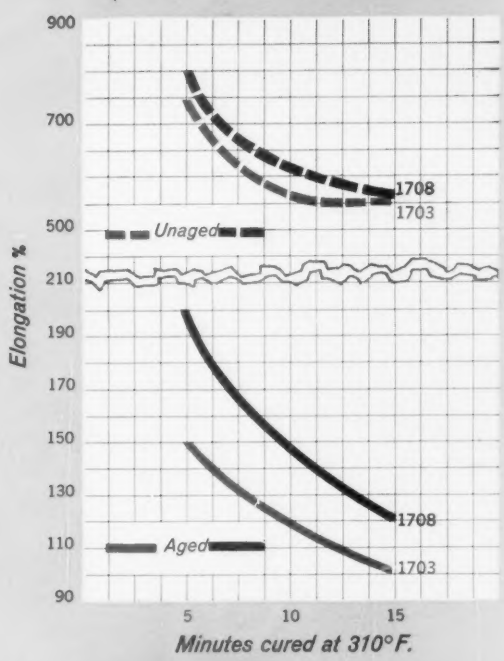
	1703	1708
Polymer	100	100
Zinc Oxide	5	5
Stearic Acid	1	1
Sunproof Wax	2	2
Cumar MH 2½	10	10
Circolite Oil	10	10
Clay	150	150
Whiting	150	150
Titanium Dioxide	5	5
Benzothiazyldisulfide	2	2
DPG	1	1
Sulfur	4	4
	440	440

OVEN AGED: 7 Days @ 158° F.

Ameripol
THE PREFERRED RUBBER



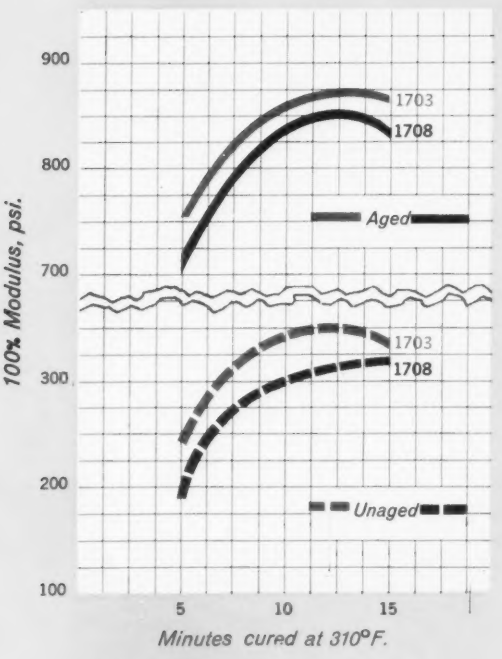
TENSILE STRENGTH



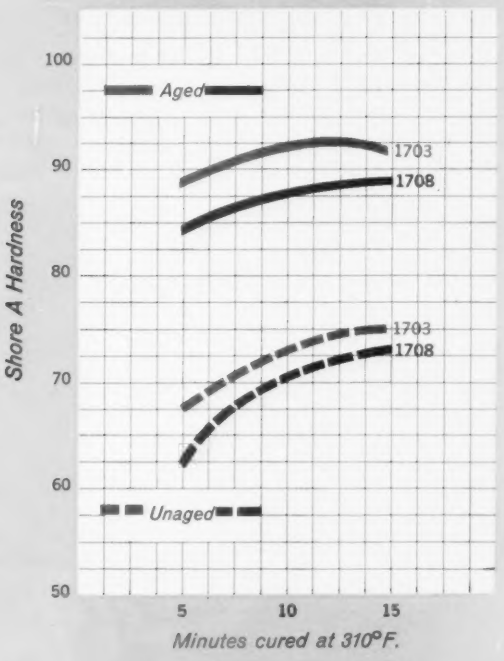
ELONGATION

Comparative tests prove performance of AMERIPOL 1708

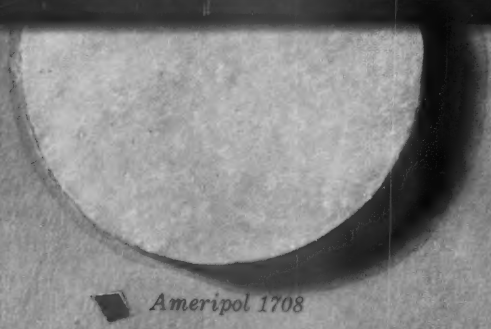
MODULUS



HARDNESS



Goodrich-Gulf Chemicals, Inc.



Ameripol 1708

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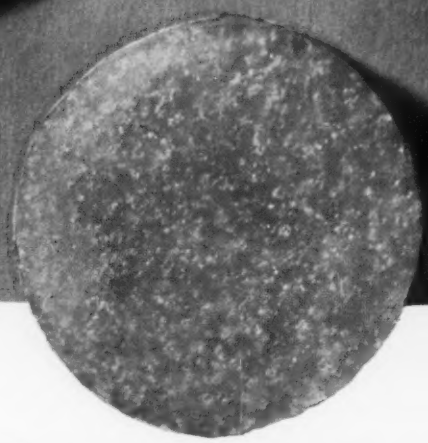
Brand "C" 1708



Brand "D" 1708

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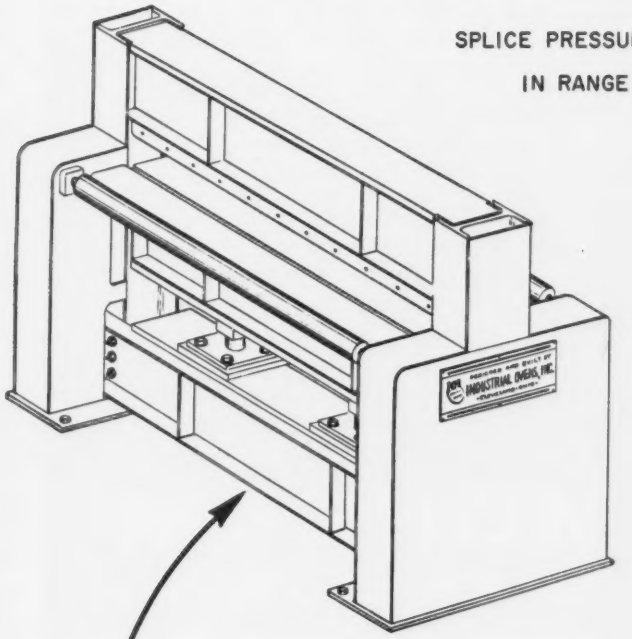

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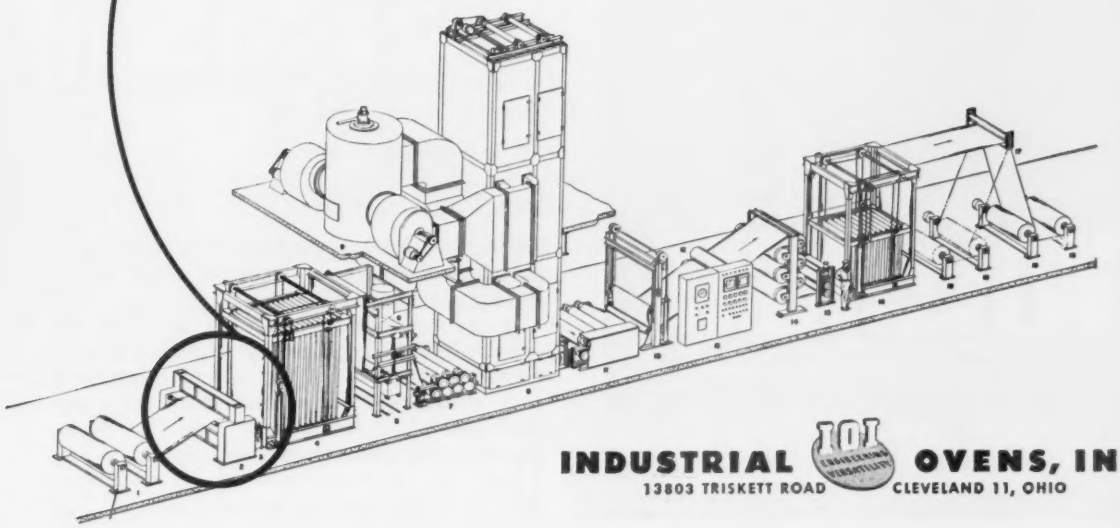

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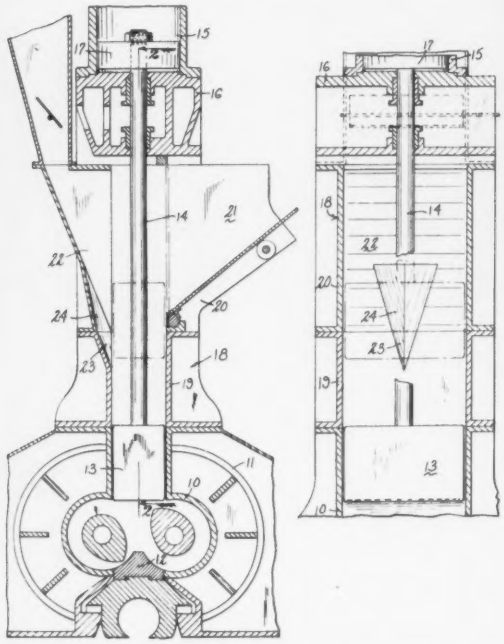
PATENT REVIEW

by Melvin Nord

Venting Device for Rubber Mixers

U. S. Patent 2,923,967, issued Feb. 9, 1960 to George W. Smith, assigned to Farrel-Birmingham Co., Inc., provides venting means for degassing the hopper of a rubber mixer such as a Banbury mixer, in which the escape of gas at the degassing period is gradual and nonexplosive and in which loss of stock which has undergone grinding or maceration is effectively inhibited.

The diagrams below depict the wall defining the mixing chamber (10), a heating jacket (11), the lower discharge door for the chamber (12), a pressure ram (13), a piston rod fastened at its lower end to the ram (14), an upper fluid cylinder (15), a base member for the cylinder (16), and a piston in cylinder (15) at (17). Also shown are a stack member (18), its lower section (19), and above it a section (20) providing a



loading opening (21). A suitable member is provided to serve as a removable cover for the loading opening or port.

A gas and dust passage (22) is at the side opposite the loading opening, extending from a point somewhat below the upper boundary of stack portion (19) to a point above the uppermost position of the pressure ram. The lowermost part of the passage (23), in connection with a part (24) in section (20) of the stack, provides a valving part in the dust passage. This

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part, as shown in the right drawing is of V shape in elevation, the part (23) having vertical side portions against which the ram (13) may contact as it is moved vertically. The other part (24) of this passage section has its inner sides sloped upwardly and laterally, as shown in the left drawing, so as not to have contact with the adjacent face of the ram.

The ram is rectangular in horizontal and vertical section. One of its lateral faces contacts the part in which the passage portion (23) is formed. The shape of this portion is such that when the mixer is in the operating position, as shown in the left drawing, the ram is in a position to close this passage against discharge of gas. But, when the lower edge of the ram moves upwardly to a very small degree beyond passage portion (23), gas in the lower portion of the stack starts to issue into the dust passage. As the ram continues its movement, the capacity of the passage is continually enlarged, thus increasing the flow of gas gradually but continuously within proper limits.

In this manner, violent disturbance or explosion in the chute, incidental to the opening of the gas passage, is inhibited, and dust-carrying gas is eliminated quickly without malfunctioning of the apparatus and without loss of stock material intended to be retained in the mixing chamber.

Reclaiming Rubber-Covered Nylon Scrap

U. S. Patent 2,921,038, issued Jan. 12, 1960 to Arnold Gunther, assigned to Samuel Lipetz and Alexander Lipetz, provides a method of separating and reclaiming both the nylon fiber and the unvulcanized rubber contained in scrap of rubber-covered nylon fiber in a practically clean, reusable condition.

First, the scrap is immersed in a solvent, like carbon tetrachloride, for unvulcanized rubber. The dissolved rubber is then separated from the fibers by filtration. This process is repeated several times until no more rubber can be extracted from the fibers. Solvent absorbed by the fibers is evaporated by heating, then recovered by condensation.

Next, the fibers are immersed in an aqueous solution of an oxidizing agent like sodium hypochlorite. After a few hours, the fibers are separated from the solution by decantation. The fibers are then put in a ball-mill filled with water. The action of the balls on the fibers removes all impurities. The fibers are then separated, washed free of the oxidizing agent, and dried in hot air. Rubber is reclaimed by evaporating the solvent from the rubber solution.

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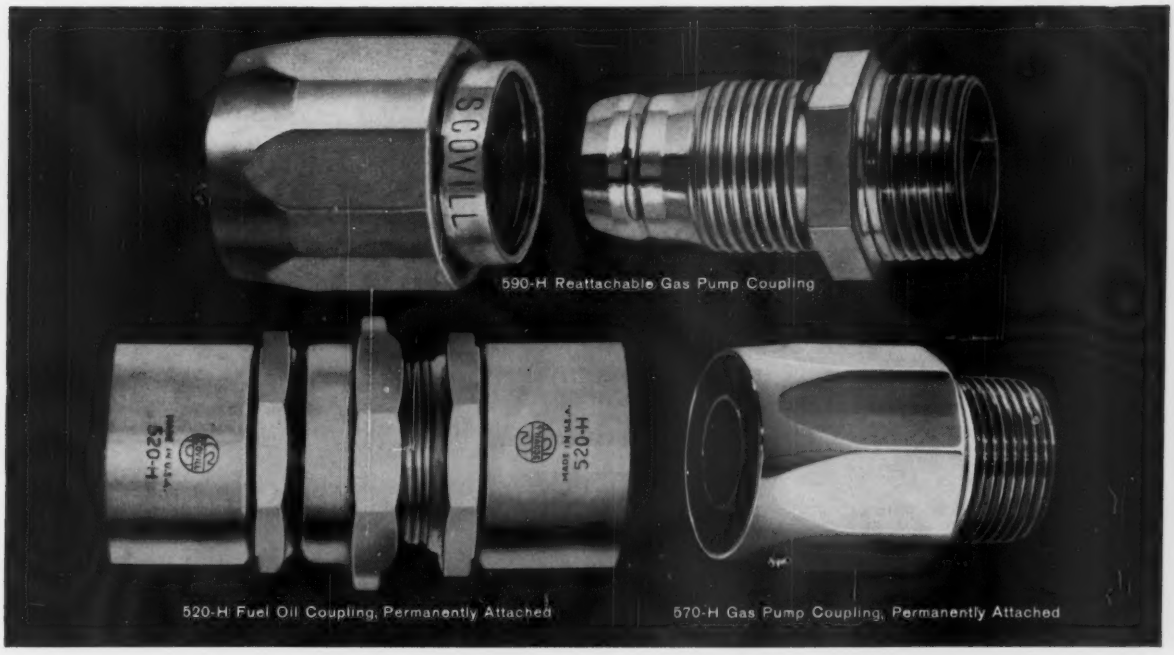

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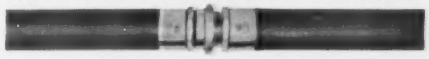

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PATENT REVIEW

Bonding Textiles to Rubber

U. S. Patent 2,927,051, issued March 1, 1960 to Howard M. Buckwalter and Joseph M. Almand, assigned to United States Rubber Co., describes a method of bonding textiles to rubbers with resorcinol and diaryl guanidine formaldehyde reaction product. The resorcinol and the reaction product, upon heating, form an adhesive-like condensation product at the interface between the textile and the rubber.

Other Patents of Interest

Subject	Inventor or Assignee	Patent No.	Date
Expansible tire chuck	Robbins Tire & Rubber Co.	2,924,255	2/9/60
Machine for slitting tires	Micro Machinery Products, Inc.	2,924,267	2/9/60
Tire truing device	Gresham R. Holton et al	2,924,268	2/9/60
Traction increasing and safety device	Rudolph O. Blaschke	2,924,486	2/9/60
Tire construction	Bernard Seaman	2,925,112	2/16/60
Tire tread cutting machine	Kenneth D. Curry	2,925,125	2/16/60
Conveyor belt	B. F. Goodrich Co.	2,925,165	2/16/60
Reclaiming of uncured and compounded latex foam stock	General Motors Corp.	2,925,396	2/16/60
Vehicle tire	Continental Gummi-Werke A. G.	2,925,623	2/23/60
Tire composed of two concentric annular chambers	Curtiss-Wright Corp.	2,925,845	2/23/60
Multiservice protector unit for tires and tubes	Hansford D. Hurt	2,925,846	2/23/60
Rubber boot method of bearing preservation	Secretary of the Navy	2,926,066	2/23/60
Tire tread	U. S. Rubber Co.	2,926,715	3/1/60
Tire building drum	Goodyear Tire & Rubber Co.	2,926,721	3/1/60
Disc brake	Goodyear Tire & Rubber Co.	2,926,757	3/1/60
Rubber fender structure	Robert W. Erlbacher	2,926,904	3/1/60

Copies of any patents, including those described here, are available from the Commissioner of Patents, Washington 25, D. C., for 25 cents each. Do not send stamps.

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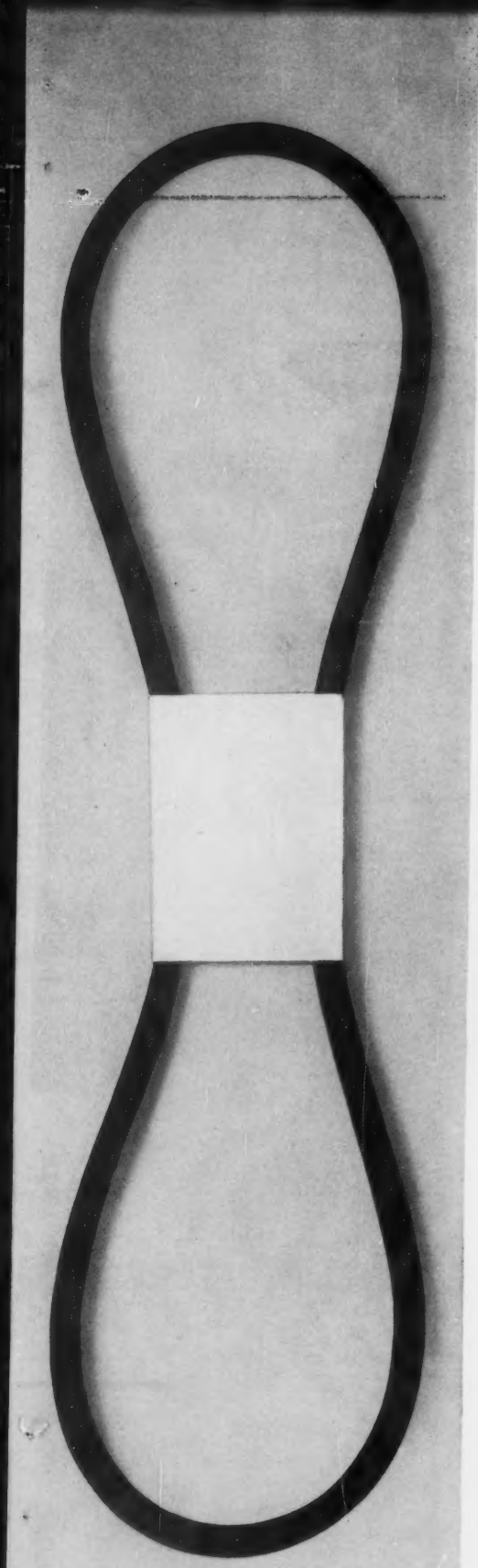

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154	"	for natural rubber, nonblack
276	"	for styrene rubber, black
150	"	for styrene rubber, nonblack
259	"	for nitrile rubber, black
97	"	for nitrile rubber, nonblack
254	"	for neoprene, black
116	"	for neoprene, nonblack
101	"	for butyl, black
57	"	for butyl, nonblack
50	"	for polysulfide, black and nonblack
36	"	for reclaim (all black compounds)
45	"	for Hypalon, black and nonblack
86	"	for silicone rubber, black and nonblack
92	"	for vinyls (all nonblack compounds)
100	"	for miscellaneous other rubbers, black and nonblack
156	"	for blends of general purpose rubbers (natural, styrene, butyl, reclaim), black
71	"	for blends of general purpose rubbers, nonblack
77	"	for blends containing oil-resistant rubbers, black
73	"	for blends containing oil-resistant rubbers, nonblack
2365	compounds	Total

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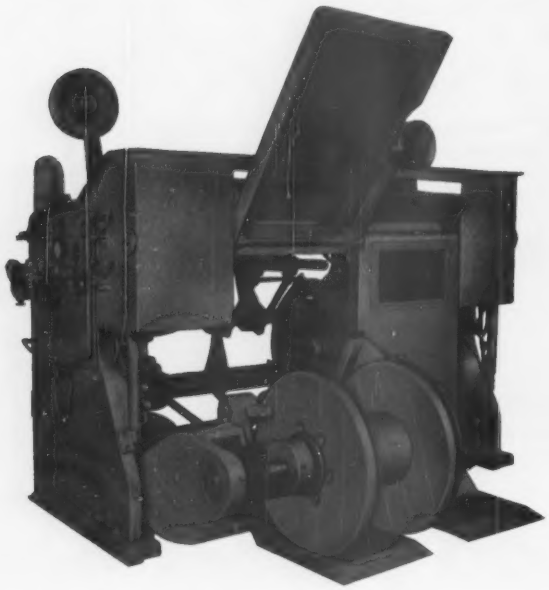

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News in Brief

► The Electric Storage Battery Co. Philadelphia, Penna., has announced the purchase of the assets and business of the Wisconsin Storage Battery Co., Racine, Wisc.

► The development of a new system for spraying plastic foam is described and outlined in a seven-page report issued by Wyandotte Chemicals Corp., Wyandotte, Mich.

► National Cylinder Gas Division of the Chemetron Corp. has announced that it is using neoprene exclusively in the manufacture of its anesthesia equipment. Neoprene harmlessly carries away static electricity created in anesthesia apparatus, the company states.

► Anaconda Wire & Cable Co. has published a new 32 page catalog on design features, insulations available and performance highlights of Durasheath, the company's butyl (AB) cable. Write to Dept. EFL, 25 Broadway, New York, N. Y., for Catalog No. 102.

► A simplified temperature conversion chart from Fahrenheit to Centigrade and from Centigrade to Fahrenheit is available, free of charge, from Beacon Chemical Industries, Inc., 33-51 Richdale Ave., Cambridge 40, Mass.

► Minnesota Rubber Co., 3630 Wooddale Ave., Minneapolis, Minn., has issued a new brochure on its Prototypes by Kotokast. The folder describes how this process fits into design programs; what materials can be used; and shows how the technique helps to achieve economy, fast service and flexibility in testing programs.

► Columbia - Southern Chemical Corp., Barberton, Ohio, has issued a booklet, "Fine Particle Reinforcing Silicas and Silicates in Elastomers," Hi-Sil Bulletin No. 20, which touches on manufacturing methods, and the physical and chemical properties of commercially available reinforcing silicas and silicates.

► A new price list of poly-dispersions, low Mooney, solid, slab-form dispersions of rubber chemicals in polyisobutylene binders, is available in attractive brochure form from Wyrough & Loser, Trenton, N. J.

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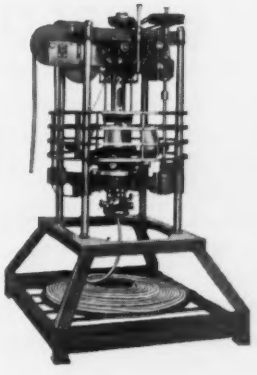

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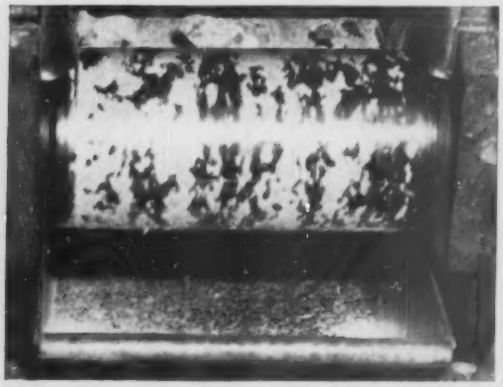

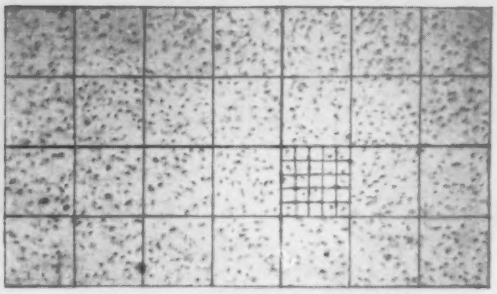

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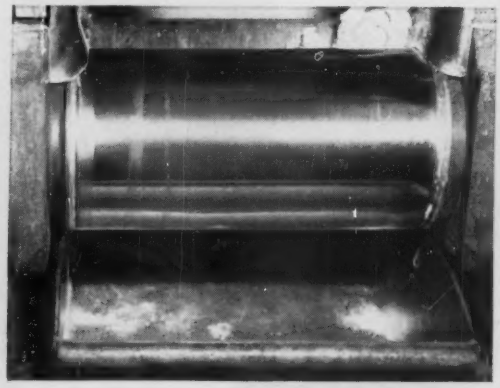

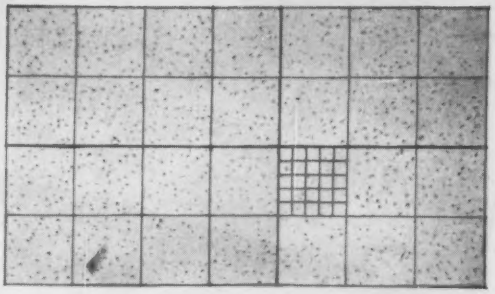

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Division of United States Rubber Company

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Naugatuck PARACRIL OZO

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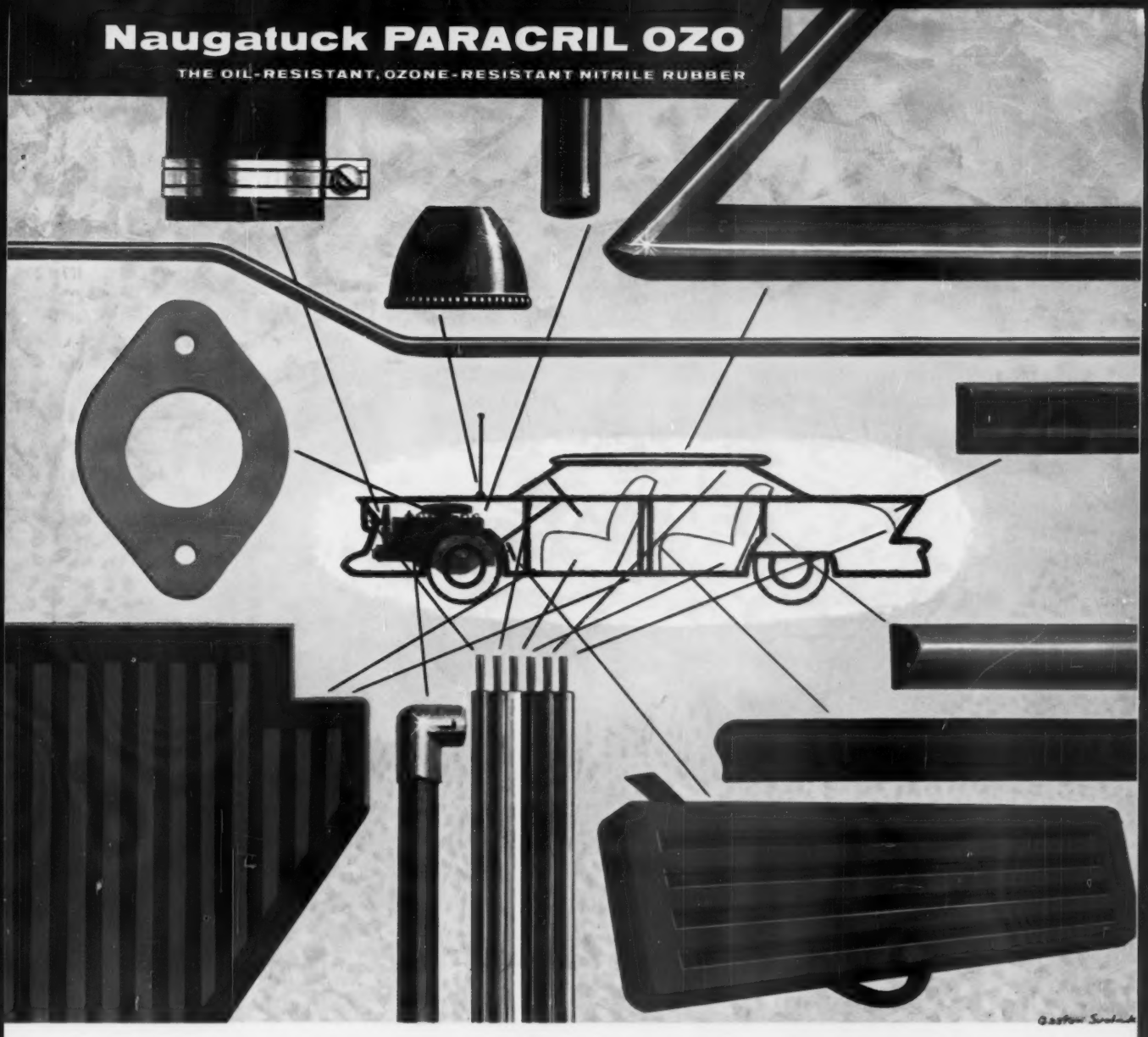

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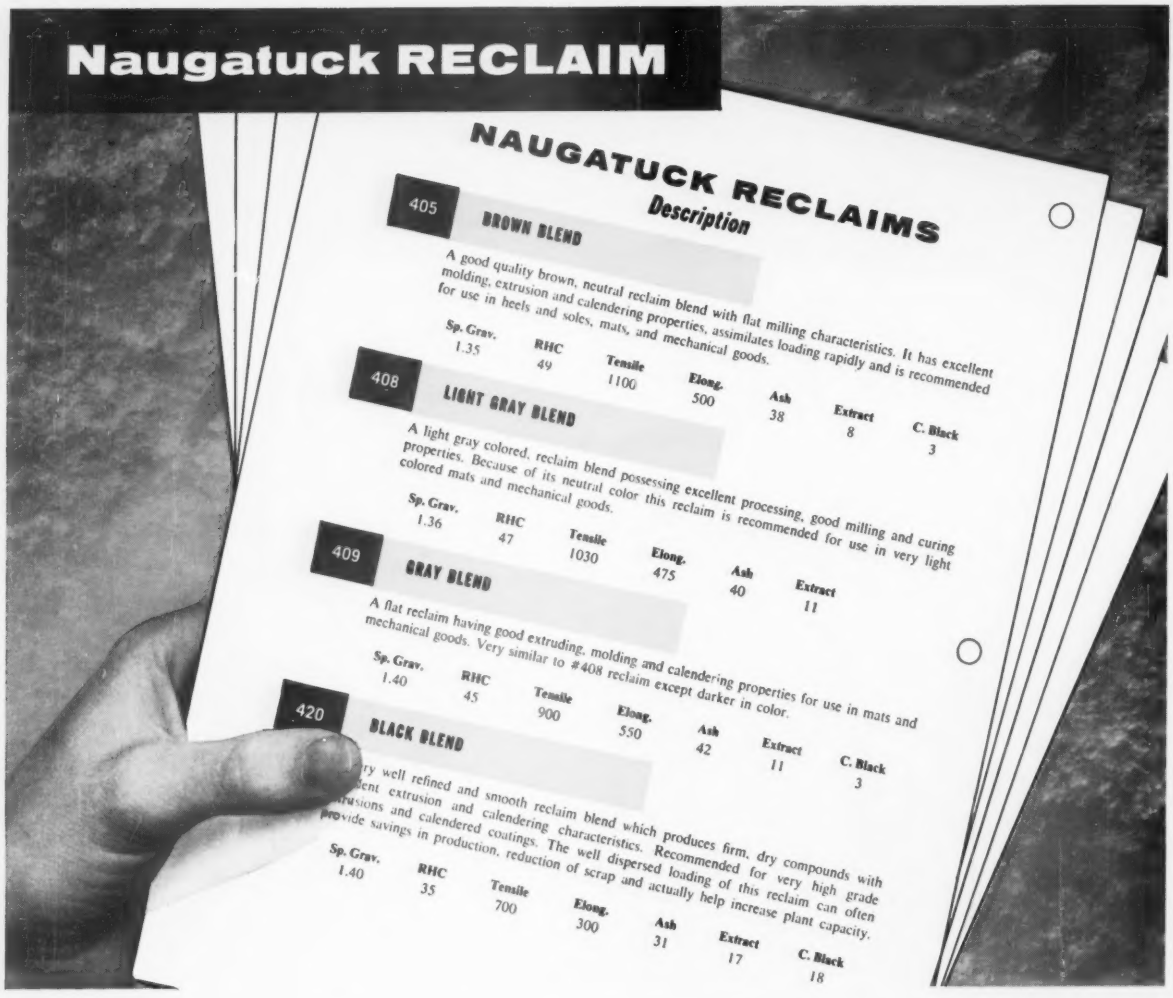
Naugatuck RECLAIM
NAUGATUCK RECLAIMS
Description
405
BROWN BLEND
A good quality brown, neutral reclaim blend with flat milling characteristics. It has excellent molding, extrusion and calendering properties, assimilates loading rapidly and is recommended for use in heels and soles, mats, and mechanical goods.
Sp. Grav. 1.35
RHC 49
Tensile 1100
Elong. 500
Ash 38
Extract 8
C. Black 3
408
LIGHT GRAY BLEND
A light gray colored, reclaim blend possessing excellent processing, good milling and curing properties. Because of its neutral color this reclaim is recommended for use in very light colored mats and mechanical goods.
Sp. Grav. 1.36
RHC 47
Tensile 1030
Elong. 475
Ash 40
Extract 11
409
GRAY BLEND
A flat reclaim having good extruding, molding and calendering properties for use in mats and mechanical goods. Very similar to #408 reclaim except darker in color.
Sp. Grav. 1.40
RHC 45
Tensile 900
Elong. 550
Ash 42
Extract 11
C. Black 3
420
BLACK BLEND
provide savings in production, reduction of scrap and actually help increase plant capacity.
Sp. Grav. 1.40
RHC 35
Tensile 700
Elong. 300
Ash 31
Extract 17
C. Black 18

Do you know the advantages of Reclaimed Rubber?

Naugatuck's Reclaimed Rubber offers many definite and proven advantages over virgin rubber.

STABLE LOW COST—Price of whole tire reclaim is consistently about ⅓ that of natural rubber. And reclaim already contains many valuable additives.

UNIFORM MATERIAL—Rigid control of processing provides reclaimed rubber with remarkable uniformity.

SHORT MIXING TIME—Because reclaimed rubber has, in a sense, been pre-mixed, mixing time is much shorter than with natural or synthetic rubber.

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RUBBER AGE/Vol. 87, No. 6/Sept., 1960

By Ralph F. WOLF* and Robert R. MELTZ
Columbia-Southern Chemical Corp.
Barberton, Ohio

Compounding LIGHT COLORED Rubber Rolls

A practical guide to production stocks—based on four commonly used elastomers

RUBBER covered rollers are important production tools in a score of industries.

The compounder of industrial roll stocks is called upon to meet as wide a variety of physical properties as are encountered in the manufacture of any type of rubber goods. This results from the widely varied uses to which rolls are put. Best known perhaps are those in printing, in textile manufacture and in the paper industry, which employs the greatest number of rolls for a variety of purposes. But rubber rolls also find employment in such varied occupations as cracking nut shells, squeezing seeds out of raisins, pulling hair out of hides, moving brittle sheets of glass or tough sheets of steel through finishing processes, embossing plastic films—and dozens of other operations in the textile, food processing, metal, leather, glass, plywood and other industries.

*Mr. Wolf is currently with the Natural Rubber Bureau, Akron 19, Ohio.

The reason for such widespread use of rubber for roll covering does not lie in any single quality, unless versatility can be described as a quality. Rubber compounds for rolls can be made as hard as bone or as soft as a gumdrop. They can be tough enough to resist the gouging of a rough-edged steel sheet or soft enough to squeeze water from a web of wet paper only a few thousandths of an inch thick. They are superior to metal in resistance to abrasion, to water, to oxidizing materials and to the corrosive action of all kinds of acids, alkalies and salts and, consequently, are used to protect metal against all of these conditions. Likewise, rubber is superior to wood in all of the characteristics just mentioned, as well as in resistance to temperature and humidity. It does not swell, nor does it dry out, split or crack.

Durometer A hardness required of a roll compound may be less than 15 or more than 100. Varying degrees of oil and solvent resistance are required, de-

pending on the application. Some rolls must be able to withstand long hours of exposure to boiling water, or to corrosive pickling, plating or oxidizing solutions. Others are expected to withstand severe aging conditions, particularly at high temperature.

Seemingly the covering of a roller with rubber is not complicated. The shape of the finished product is a simple one. If dimensions are critical, they can be adjusted by grinding after vulcanization. Actually roll production is a complex process. The rubber compound must mix easily and yet all ingredients must be *completely* dispersed. The appearance of specks of undispersed material, as a vulcanized roll is ground, may render it completely worthless.

The compound must calender smoothly and be free of blisters. It must have good building tack, yet be easy to pull out of the liners in which it is stored. It must have a long scorch time, because roll batch stock is seldom completely used for any given order, and material returned from storage or from building operations must stand remilling and recalendering.

The vulcanized roll must have the right combination of hardness and durability. According to the service encountered, it must have either a good gripping or a non-sticking surface. It must grind and polish easily. It must resist heat, water, light, and a wide variety of oils, solvents and strong chemicals. It often must survive unusual handling and storage conditions. Because it is expensive in itself and its replacement may entail a long shutdown of costly equipment, it is expected to give unusually long service in spite of severe flexing and compression, snagging, cutting, abrasion and other physical or chemical effects.

When Smudging Has To Be Avoided

In many industrial applications, rolls must be non-marking because they come into contact with materials which must not be smudged, e.g., paper, textiles, foodstuffs, and plated metal surfaces. Producing any of these, what a textile man calls "mark-off" must be avoided. In addition, press men increasingly favor non-black printing roll covers, so that they can be sure of obtaining a clean surface when "washing up" from one color change to another.

As a consequence, roll compounders frequently must avoid use of carbon black for reinforcement of their stocks and turn to non-black fillers. Reinforcing silica, such as Hi-Sil 233, is used where carbon

TABLE I—SOFT NR ROLL COMPOUNDS
(25 to 40 Durometer A)

	No. 1	No. 2	No. 3	No. 4	No. 5	No. 6
No. 1 Smoked Sheets	100	100	100	100	100	100
Neophax A	125	—	100	—	100	—
Zinc Oxide	5	5	5	5	5	5
ELC Magnesium Oxide	—	—	—	—	10	—
Hi-Sil 233	30	10	30	20	30	10
Calcene TM	—	14	—	28	—	14
Antioxidant 2246	—	2	2	2	2	2
Agerite Resin D	2	—	—	—	—	—
PBNA	3	—	—	—	—	—
MBTS	1.75	1.5	0.8	1.5	1.75	1.5
DOTG	—	—	0.3	—	—	—
Sulfur	5	2.5	2.5	2.5	5	2.5
Triethanolamine	0.20	0.5	1	0.5	1	0.5
Light Process Oil	25	—	—	—	—	—
Petrolatum	—	25	—	25	—	—
Stearic Acid	2	—	1	—	1	—
Specific Gravity	1.13	1.05	1.09	1.13	1.14	1.10
Mooney Viscosity (LR 212°F.)	28	12	29	24	38	48
Mooney Scorch*	23	27	16¼	>30	7½	16
Physical Properties for Optimum Cure at 287°F.:						
Time of Cure (min.)	45	15	30	15	15	15
Tensile (psi.)	780	2740	1140	1940	1170	3770
Modulus (300% E.)	240	200	330	300	400	490
Modulus (500% E.)	360	710	580	980	760	1750
Elongation (%)	710	760	680	660	630	650
Hardness (Shore A)	27	29	34	37	37	38
Tear (lb./in.)	110	140	200	140	190	280
Comp. Set. (Method B, 22 hrs. at 158°F., 30 min. cure)	—	35.6	81.1	36.8	85.3	19.0
Properties After Air Oven Aging, 7 days at 158°F.:						
Tensile (psi)	—	3610	1200	2780	1210	4660
Modulus (300% E.)	—	410	530	470	520	770
Elongation (%)	—	690	570	640	580	620
Hardness (Shore A)	—	36	43	42	40	42

*Minutes to 5 point rise above minimum viscosity. S.R. 250°F.

black properties are required in light or neutral-colored stocks. This type of filler is widely used also in extremely soft compounds where as much quality as possible must be obtained at very low loadings. If lower quality is acceptable, a cost saving can be made by diluting the reinforcing silica with silicate fillers such as Silene EF, precipitated carbonates like the Calcenes, or clay.

In this article an attempt is made to provide the roll compounder with a number of formulations which can serve as starting points for production stocks. Compounds based on each of the commonly used elastomers (NR, CR, NBR, and polysulfide rubber) are shown in a wide range of hardnesses.

Natural Rubber Preferable to Styrene

No attempt has been made to include SBR formulations because this elastomer has little to offer the roll compounder. Obviously NR and SBR can be used only in those rolls where oil resistance is not a factor. Although cheaper compounds can be made with SBR, the actual pound cost of the cover stock has little bearing on the total cost of an expensive industrial roll. The slight saving in compound costs which could be made using SBR instead of NR would be more than offset by the building difficulties and subsequent defects caused by SBR's lack of tack. Natural rubber is greatly preferred over SBR for rolls not requiring oil and solvent resistance.

It has been pointed out already in the introduction that NR is used in roll compounds only when oil resistance is not a factor. There is one exception to this statement, but it holds in general, with NR rolls finding use principally where good physical properties and high resilience are required in a non-oily environment.

The exception: Natural rubber compounds are used for high speed newspaper printing rolls in spite of the fact that this polymer is not generally suited for printing because of its lack of resistance to oils and ink solvents. Inks used in printing newspapers are simple mixtures of carbon black and mineral oil. Such inks do not dry by themselves on the rollers which, consequently, do not require any washing. NR compounds satisfactorily handle the problems of high temperatures and high centrifugal forces accompanying high speed press operation. If properly compounded, they do not swell uncontrollably in the type of ink used.

TABLE II—MEDIUM HARDNESS NR ROLL COMPOUNDS
(40 to 60 Durometer A)

	No. 7	No. 8	No. 9	No. 10	No. 11	No. 12	No. 13
No. 1 Smoked Sheets	100	100	100	100	100	100	100
Neophax A	—	50	—	—	—	—	—
Zinc Oxide	5	5	5	5	5	5	5
ELC Magnesium Oxide	—	—	—	—	10	10	10
Hi-Sil 233	10	30	20	20	30	39	39
Calcene TM	28	—	28	42	—	—	—
Antioxidant 2246	2	2	2	2	—	—	—
PBNA	—	—	—	—	2	2	2
MBTS	1.5	0.8	1.5	1.5	1.5	—	0.8
DOTG	—	0.3	—	—	—	—	—
Triethanolamine	0.5	1	0.5	0.5	1	1	1.2
Sulfur	2.5	2.5	2.5	2.5	3	5	3
Process Oil	—	—	—	—	10	7	7
Stearic Acid	—	1	—	—	2	2	2
Specific Gravity	1.15	1.10	1.18	1.24	1.19	1.20	1.19
Mooney Viscosity (LR 212°F.)	42	36	48	48	54	67	67
Mooney Scorch*	19	11	22	25	11	10	8
Physical Properties for Optimum Cure at 287°F.							
Time of Cure (min.)	15	30	30	15	15	60	30
Tensile (psi)	3650	2270	2590	2770	3630	3140	3440
Modulus (300% E.)	560	440	430	510	740	590	800
Modulus (500% E.)	1920	1020	1320	1580	2120	1450	2170
Elongation (%)	640	680	660	630	640	720	650
Hardness (Shore A)	43	43	46	49	50	56	57
Tear (lb./in.)	500	420	200	370	550	460	550
Comp. Set (Method B, 22 hrs. at 158°F., 30 min. cure)	18.1	61.1	31.6	34.8	—	35.1**	—
Properties After Air Oven Aging, 7 days at 158°F.							
Tensile (psi)	4470	2540	4070	3670	—	—	—
Modulus (300% E.)	840	690	710	810	—	—	—
Elongation (%)	610	630	650	620	—	—	—
Hardness (Shore A)	52	50	50	55	—	—	—

*Minutes to 5 point rise above minimum viscosity. S.R. 250°F.

**60 minute cure

Oily materials are not present in paper manufacturing, therefore many NR compounds are used in paper machine rolls. The resiliency of natural rubber, much higher than that of any of the synthetics, leads to its use in operations where this is an important factor, as in rolls for embossing vinyl and other plastic films.

A series of NR roll stocks with low Durometer hardnesses—from 27 to 38—are described in Table I. Low hardness has been achieved in these stocks by use of large amounts of softener or factice. The specific effect of softener on hardness is well illustrated by comparing "Compound 2" and "6." These are identical except for the presence of softener which has made "Compound 2" 9 points softer. The same effect is noticed in comparing "Compound 1" and "5" which are basically similar but for softener content. This table also indicates that combinations of reinforcing silica with a precipitated carbonate are useful for obtaining reasonable physical properties at low hardness.

Fillers Can Influence Hardness of Rolls

Reduction of softener and increases in loading result in a series of NR compounds having hardnesses from 43 to 57, as shown in Table II. Effect of increasing Hi-Sil 233 by 10 phr without making any other change is seen by comparing "Compound 7" and "9"; of increasing Calcene TM, by comparing "9" and "10."

Four NR compounds having hardnesses from 62 to 80 are listed in Table III. By comparing "Compound 13" of the previous table with "Compound 14" and "15"—all of them basically identical—an increase in sulfur or the addition of a secondary accelerator can be noted as it affects hardness. The effect on hardness, tensile and tear of addition of clay to a Hi-Sil loaded compound can be seen by comparing "Compound 16" and "17."

Two very high hardness compounds, suitable for paper mill rolls, are described in Table IV. Hardnesses above 90 are achieved by a combination of high pigment loading and high sulfur.

Press roll covers are often quite thick, requiring long cures at relatively low temperatures. These vulcanization conditions are best met by use of high sulfur and inorganic acceleration. A series of suitable compounds are shown in Table V. These compounds, excluding "25," are identical except for loading. Hardnesses ranging from 53 to 75 were obtained by simply varying the filler content. A comparison of "Compound 25" and "26" illustrates the effect of a small amount of softener on plasticity, scorch, tensile, modulus and hardness.

Using More Sulfur and Longer Cures

The effect of increasing sulfur in this type of compound, holding filler constant, is shown in Table VI. Hardness increases from 62 to 75 when sulfur content is raised from 5 to 18 phr.

Compounds suitable for thin press roll covers, for which shorter vulcanization times are satisfactory, are described in Table VII. Unlike the stocks of Table V, these are based on normal sulfur and organic

TABLE III. MEDIUM HIGH HARDNESS NR ROLL COMPOUNDS
(60 to 80 Durometer A)

	No. 14	No. 15	No. 16	No. 17
No. 1 Smoked Sheets	100	100	100	100
Zinc Oxide	5	5	5	5
ELC Magnesium Oxide	10	10	—	—
Hil-Sil 233	39	39	62	62
Hard Clay	—	—	—	25
PBNA	2	2	2	2
MBTS	1.5	0.8	1.5	1.5
DOTG	—	1.2	—	—
Sulfur	5	3	3	3
Triethanolamine	1	1	1	1
Process Oil	12.5	7	5	5
Stearic Acid	2	2	2	2
Specific Gravity	1.21	1.20	1.22	1.30
Mooney Viscosity (LR 212°F.)	67	67	111	120
Mooney Scorch*	11	6	—	—
Physical Properties for Optimum Cure at 287°F.				
Time of Cure (min.)	45	15	60	60
Tensile (psi)	3240	3770	2920	2790
Modulus (300% E.)	930	1020	930	1250
Modulus (500% E.)	2180	2770	2290	2550
Elongation (%)	610	610	570	540
Hardness (Shore A)	62	62	76	80
Tear (lb./in.)	470	520	540	370

*Minutes to 5 point rise above minimum viscosity. S.R. 250°F.

TABLE IV. HIGH HARDNESS NR ROLL COMPOUNDS
(Above 90 Durometer A)

	No. 18	No. 19
No. 1 Smoked Sheets	100	100
Zinc Oxide	5	5
ELC Magnesium Oxide	10	10
Hi-Sil 233	65	65
Calcene TM	15	15
PBNA	2	2
MBTS	2.5	2.5
Sulfur	15	30
Triethanolamine	1	1
Polyethylene 617-A	1	1
Pine Tar	3	3
Stearic Acid	3	3
Specific Gravity	1.35	1.38
Physical Properties for 90 min. at 275°F. Cures:		
Tensile (psi)	2170	2130
Modulus (300% E.)	1620	1960
Elongation (%)	440	340
Hardness (Shore A)	85	89
Tear (lb./in.)	470	470
Physical Properties for 180 min. at 274°F. Cures:		
Tensile (psi)	2070	2313
Modulus (300% E.)	2040	—
Elongation (%)	310	120
Hardness (Shore A)	91	98
Tear (lb./in.)	460	180

TABLE V. THICK NR PRESS ROLL COVER COMPOUNDS REQUIRING LONG CURE
(50 to 75 Durometer A)

	No. 20	No. 21	No. 22	No. 23	No. 24	No. 25	No. 26	No. 27
No. 1 Smoked Sheets	100	100	100	100	100	100	100	100
Zinc Oxide	5	5	5	5	5	5	5	5
ELC Magnesium Oxide	10	10	10	10	10	10	10	10
Hi-Sil 233	30	30	40	40	50	50	50	70
Calcene TM	—	42	—	28	—	14	14	—
PBNA	2	2	2	2	2	2	2	2
Sulfur	9	9	9	9	9	9	9	9
Wood Rosin	3	3	3	3	3	3	3	3
Bondogen	—	—	—	—	—	5	—	—
Stearic Acid	2	2	2	2	2	2	2	2
Specific Gravity	1.18	1.32	1.20	1.31	1.24	1.28	1.29	1.28
Mooney Viscosity (LR 212°F.)	39	44	57	52	81	46	83	144
Mooney Scorch*	12½	10½	16½	12½	20	30	17½	5½
Physical Properties for 3 Hours at 274°F. Cures:								
Tensile (psi)	3440	2620	3410	2660	3170	2590	2950	2940
Modulus (300% E.)	540	560	640	670	850	510	930	1290
Modulus (500% E.)	1250	1300	1540	1500	1890	1250	1960	2330
Elongation (%)	740	690	720	680	660	700	640	600
Hardness (Shore A)	53	57	57	60	65	66	70	75
Tear (lb./in.)	390	370	470	400	460	440	450	600
Comp. Set (Method B, 22 hrs. at 158°F.)	24.8	30.2	24.2	32.3	30.5	36.4	35.2	46.9
Properties After Air-Oven Aging, 7 Days at 158° F.:								
Tensile (psi)	3110	2340	3060	2370	3160	2390	2670	2990
Modulus (300% E.)	920	1000	1210	1230	1580	1010	1620	2490
Elongation (%)	630	590	610	520	580	600	500	420
Hardness (Shore A)	60	69	69	70	80	70	80	82

*Minutes to 5 point rise above minimum viscosity. S.R. 250°F.

acceleration. A range of hardnesses from 56 to 84 is obtained again by varying the filler loading and acceleration required at the higher loadings.

Neoprene roll covers are used for many applications and compound requirements extend over the entire hardness range.

TABLE VI. EFFECT OF INCREASED SULFUR CONTENT ON PRESS ROLL COVER COMPOUND REQUIRING LONG CURE

	No. 28	No. 29	No. 30
No. 1 Smoked Sheets	100	100	100
Zinc Oxide	5	5	5
ELC Magnesium Oxide	10	10	10
Hi-Sil 233	48	48	48
PBNA	2	2	2
Sulfur	5	12	18
Triethanolamine	1	1	1
Process Oil	5	5	5
Stearic Acid	2	2	2
Specific Gravity	1.23	1.25	1.27
Mooney Viscosity (LR 212°F.)	90	89	90
Physical Properties for 60 Min. at 287°F. Cure:			
Tensile (psi)	3250	3370	2910
Modulus (300% E.)	770	1000	1370
Modulus (500% E.)	1820	2270	2540
Elongation (%)	700	650	550
Hardness (Shore A)	62	68	75
Tear (lb./in.)	560	460	490

In addition to reasonably good resistance to oils and solvents, low Durometer hardness is frequently required of printing rolls. Cushion type rolls are made with a 12 to 15 Durometer cushion and 20 to 30 face stock. Letterpress rolls are in the 15 to 30 range and newspaper rolls 30 and above. Four compounds having hardnesses between 15 and 35 are listed in Table VIII. As would be expected, physical properties of these compounds are not particularly good because of the large amounts of factice and processing oil used to get low hardness.

Compounding for Medium High Durometer

Properties of four compounds in the medium hardness range (40 to 60) are given in Table IX. All of these stocks have excellent physical properties. Rolls from these compounds are used in tin plate mills and are called on to operate continuously in 190° to 200° F. water. Table IX shows that the water resistance of Hi-Sil loaded neoprene is very good.

Properties of four compounds in a medium high hardness range—60 to 70—are listed in Table X. Tannery rolls are included in this group.

Roll compounds having high hardness—70 to 95—are described in Table XI. Rotogravure rolls generally have a Durometer hardness of about 80, wax rolls about 90. This table illustrates three different methods of obtaining high hardness: employing high styrene resin, additional loading of clay on top of a normal Hi-Sil loading, or using a high Hi-Sil loading.

Diethylene Glycol for Water Resistance

Diethylene glycol is not indicated in many of the recipes in Tables VIII to XI. The part played by this ingredient in Hi-Sil or Silene-loaded neoprene roll compounds is an unusual one which requires explanation. The effect of diethylene glycol in Silene loaded stocks has been described *(1)* as follows: "The addition of diethylene glycol to a Silene EF loaded Neoprene GN compound does not have much effect on rate of cure. Modulus is increased somewhat but tensile strength and tear resistance are little affected. Hardness is increased considerably. Most important, from the standpoint of commercial utilization in such things as roll compounds, is the fact that the hardness of a glycol-Silene EF stock does not change significantly during continuous exposure to boiling water."

The same statement is applicable to a Hi-Sil 233 loaded neoprene stock. If a neoprene roll is not going to be exposed to water in service, there is no particular reason to include diethylene glycol in its formulation. If it is going to be exposed to water, it is suggested that slightly less Hi-Sil be used than would normally be required to give a particular hardness. The hardness can then be brought up to the required range by addition of glycol so as not to be increased undesirably during service.

A combination of good physical properties with high resistance to oils and solvents has made the acrylonitrile-butadiene copolymers (NBR) popular materials for production of industrial rolls.

Overcoming the Problem of Building Tack

One of the principal processing problems in making NBR rolls has always been lack of building tack. Hi-Sil is a particularly good filler for this purpose, because NBR compounds loaded with it have more building tack than if loaded with other reinforcing fillers or with inert non-black fillers. This contribution to tack production is not obtained in soft Durometer compounds where the Hi-Sil loading is purposely kept low. In such formulations KP-555, which is better than many other plasticizers in respect to tack, has been used. The coumarone resins, shown in most of the compounds in Tables XII to XV, are included for their contribution toward improvement of tack.

TABLE VII. SHORT CURE OF THIN NR PRESS ROLL COVER COMPOUNDS

(55 to 85 Durometer A)

	No. 31	No. 32	No. 33	No. 34	No. 35	No. 36	No. 37	No. 38
No. 1 Smoked Sheets	100	100	100	100	100	100	100	100
Zinc Oxide	5	5	5	5	5	5	5	5
Hi.-Sil 233	30	40	30	40	50	50	60	70
Calcene TM	—	—	42	28	—	14	—	—
Antioxidant 2246	2	2	2	2	2	2	2	2
MBTS	0.8	0.8	0.8	0.8	0.8	0.8	0.8	1
DOTG	0.3	0.3	0.3	0.3	1.2	1.2	1.2	1.6
Sulfur	2.5	2.5	2.5	2.5	3	3	3	3
Triethanolamine	1	1	1	1	1	1	1	1
Wood Rosin	3	3	3	3	3	3	3	3
Stearic Acid	1	1	1	1	1	1	1	1
Specific Gravity	1.14	1.15	1.26	1.24	1.18	1.22	1.21	1.22
Mooney Viscosity (I.R 212° F.)	40	43	40	54	60	64	74	—
Mooney Scorch*	29¼	27	17¾	16¼	10½	9¾	13¼	—
Physical Properties for 15 Min. at 307°F. Cures:								
Tensile (psi)	4440	3900	3260	3370	3540	3150	3160	3010
Modulus (300% E.)	540	570	770	770	1060	1150	1140	1220
Modulus (500% E.)	1880	1980	2150	2210	2870	2730	2650	2500
Elongation (%)	710	660	620	630	560	550	550	560
Hardness (Shore A)	56	61	67	69	75	78	80	84
Tear (lb./in.)	620	640	550	600	540	540	590	580
Comp. Set (Method B, 22 hrs. at 158°F. 30 min. cures.)	27.6	35.7	29.0	33.8	29.5	30.6	35.8	41.1
Properties After Air Oven Aging 7 Days at 158 F.								
Tensile (psi)	4540	4160	3480	3390	3650	3370	3280	3270
Modulus (300% E.)	790	920	1110	1060	1480	1500	1600	1700
Elongation (%)	640	620	580	580	550	530	520	560
Hardness (Shore A)	62	64	70	74	82	81	86	86

*Minutes to 5 point rise above minimum viscosity. S.R. 250°F.

TABLE VIII—SOFT NEOPRENE ROLL COMPOUNDS (15 to 35 Durometer A)

	No. 39	No. 40	No. 41	No. 42
Neoprene W	80	100	100	100
Neoprene S	20	—	—	—
Neophax A	80	75	30	20
Zinc Oxide	5	5	5	5
ELC Magnesium Oxide	4	4	4	5
Hi-Sil 233	20	20	20	—
Calcene TM	—	25	—	40
PBNA	2	2	2	2
NA-22	0.5	0.5	0.5	0.5
Circo Light Oil	80	80	40	20
Stearic Acid	0.5	0.5	0.5	0.5
Diethylene Glycol	—	—	—	3
Specific Gravity	1.13	1.18	1.21	1.35
Mooney Viscosity (LR 212°F.)	19	13	19	23
Mooney Scorch*	>30	>30	>30	—
Physical Properties for 30 min. at 307°F. Cure:				
Tensile (psi)	440	650	1410	1830
Modulus (300% E.)	110	100	180	170
Modulus (500% E.)	240	240	390	330
Elongation (%)	710	880	920	890
Hardness (Shore A)	17	16	28	33
Tear (lb./in.)	40	60	120	150
Rebound (%)	63	58	64	63
Comp. Set (45 min. at 307°F. Cure) (Method B, 24 hrs. at 158°F.	49.1	44.7	23.9	24.3
Properties After Air Oven Aging 72 hrs. at 212°F. 30 min. at 307°F. Cure:				
Tensile (psi)	570	710	1410	1820
Elongation (%)	470	540	630	690
Hardness (Shore A)	35	38	45	45
Immersion in A.S.T.M. No. 1 Oil 72 hrs. at 158°F. 30 min. at 307°F. Cure:				
Tensile (psi)	610	770	1500	—
Elongation (%)	500	540	720	—
Hardness (Shore A)	41	41	40	—
Volume Increase (%)	−30.7	−29.0	−19.5	—
Immersion in A.S.T.M. No. 3 Oil. 72 hrs. at 158° F. 30 min. at 307°F. Cure:				
Tensile (psi)	160	380	820	—
Elongation (%)	430	650	640	—
Hardness (Shore A)	18	15	17	—
Volume Increase (%)	53.2	54.8	59.9	—
Immersion in SR-6 Test Fuel. 48 hrs. at 73.5°F. 30 min. at 307°F. Cure:				
Tensile (psi)	110	230	530	—
Elongation (%)	250	530	580	—
Hardness (Shore A)	15	15	16	—
Volume Increase (%)	80.2	98.9	105.7	—
Immersion in SR-10 Test Fuel. 48 hrs. at 73.5°F. 30 min. at 307°F. Cure:				
Tensile (psi)	460	670	1190	—
Elongation (%)	670	810	810	—
Hardness (Shore A)	22	22	24	—
Volume Increase (%)	− 4.9	− 4.1	8.6	—
Immersion in Water. 24 hrs. at 212°F. 30 min. at 307°F. Cure:				
Tensile (psi)	340	530	1030	—
Elongation (%)	550	680	670	—
Hardness (Shore A)	21	24	33	—
Volume Increase (%)	21.7	15.8	20.7	—

*Minutes to 5 point rise above minimum viscosity. S.R. 250°F.

TABLE IX—MEDIUM HARDNESS NEOPRENE ROLL COMPOUNDS (40 to 60 Durometer A)

	No. 43	No. 44	No. 45	No. 46
Neoprene GN	—	75	—	100
Neoprene WHV	—	25	—	—
Neoprene W	100	—	100	—
Neophax A	5	—	5	—
Zinc Oxide	5	5	5	5
ELC Magnesium Oxide	4	4	4	4
Hi-Sil 233	30	30	45	35
Agerite Stalite	2	2	2	2
TMTMS	—	—	1	—
DPG	—	—	1	0.5
Permalux	—	—	—	0.62
NA-22	0.5	—	—	—
Sulfur	—	—	0.5	—
Circo Light Oil	20	10	10	10
Cumar MH 2½	—	—	—	5
AC Polyethylene 617-A	—	2	—	—
Stearic Acid	0.5	1	—	3
Diethylene Glycol	3	—	—	—
Specific Gravity	1.31	1.38	1.40	1.37
Mooney Viscosity (LR 212°F.)	27	71	85	33
Mooney Scorch*	12	>30	>30	11
Physical Properties for Optimum Cure at 307°F.:				
Time of Cure (min.)	30 min.	30 min.	45 min.	20 min.
Tensile (psi)	2750	3320	3120	2780
Modulus (500% E.)	690	970	1600	1170
Modulus (500% E.)	690	970	1600	1170
Elongation (%)	850	920	860	730
Hardness (Shore A)	43	49	53	56
Tear (lb./in.)	240	400	540	320
Comp. Set (Method B, 22 hrs. at 158°F.)	14.6	38.9	—	—
Volume Increase in Water (%)				
3 days at 212°F.	—	30.6	—	26.4
7 days at 212°F.	—	—	—	16.8
14 days at 212°F.	—	—	—	14.3

*Minutes to 5 point rise above minimum viscosity. S.R. 250°F.

TABLE X—MEDIUM HIGH HARDNESS NEOPRENE ROLL COMPOUNDS (60 to 70 Durometer A)

	No. 47	No. 48	No. 49	No. 50
Neoprene W	100	—	—	—
Neoprene GN	—	100	100	100
Neophax A	5	—	—	—
Zinc Oxide	5	5	5	5
ELC Magnesium Oxide	4	4	4	5
Hi-Sil 233	45	40	40	40
Barytes	—	—	—	50
Antioxidant 2246	2	2	2	—
TMTMS	1	—	—	—
DOTG	1	—	—	—
MBTS	—	1	1	—
Permalux	—	0.62	0.62	—
Sulfur	0.5	—	—	—
Circo Light Oil	10	10	10	—
Dioctyl Phthalate	—	—	—	5
Cumar P-25	—	5	—	4
Stearic Acid	—	3	3	0.5
Specific Gravity	1.40	1.38	1.40	1.68
Mooney Viscosity (LR 212°F.)	79	60	63	—
Mooney Scorch*	>30	13	14	>30
Physical Properties for 30 min. at 307°F. Cure:				
Tensile (psi)	2960	2670	2710	2470
Modulus (300% E.)	1000	610	690	1120
Modulus (500% E.)	1820	1070	1210	1840
Elongation (%)	760	820	760	630
Hardness (Shore A)	62	64	67	68
Tear (lb./in.)	520	310	340	460
Comp. Set (45 min. cure. Method B. 70 hrs. at 212°F.)	70.2	—	—	—

*Minutes to 5 point rise above minimum viscosity. SR. 250°F.

NBR compounds in the 20 to 30 Durometer range are used in the printing trade for offset rolls, letterpress and magazine printing. Five compounds of this type are listed in Table XII. Can companies use varnish rollers with a 35 to 45 Durometer range, found in Tables XII and XIII, with immersion test results of 952 Durometer compound listed in table at right.

Hard Rolls for the Textile Industry

The harder nitrile rolls are widely used in the textile industry, because the polar nature of this poly-

Immersion Tests of Compound No. 63.
60 min. at 287° F. Cure.

Medium	Hardness (Shore A)	Volume Change (%)
A.S.T.M. No. 1 Oil, 72 hours at 158° F.	50	—18.4
A.S.T.M. No. 3 Oil, 72 hours at 158°F.	44	— 8.5
SR-6 Test Fuel, 24 hours at R.T.	35	20.8
SR-10 Test Fuel, 24 hours at R.T.	40	8.4
Petroleum Naphtha, 24 hours at R.T.	42	— 1.8
Ethyl Acetate, 24 hours at R.T.	25	120.7
Toluol, 24 hours at R.T.	22	14.7
Linseed Oil, 24 hours at R.T.	40	1.0
Kerosene, 24 hours at R.T.	42	14.6

TABLE XI. HIGH HARDNESS NEOPRENE ROLL COMPOUNDS
(70 to 95 Durometer A)

	No. 51	No. 52	No. 53	No. 54	No. 55
Neoprene W	100	100	100	—	—
Neoprene WRT	—	—	—	100	100
Marbon 8000	5	10	20	—	—
Zinc Oxide	5	5	5	5	5
ELC Magnesium Oxide	4	4	4	4	4
Hi-Sil 233	40	40	40	40	70
Hard Clay	—	—	—	50	—
Antioxidant 2246	2	2	2	2	2
NA-22	0.5	0.5	0.5	0.75	0.75
Circo Light Oil	2.5	2.5	2.5	5	5
Polygylcol 4000	—	—	—	4	4
Cumar P-10	2.5	2.5	2.5	—	—
Stearic Acid	1	1	1	1	1
Specific Gravity	1.43	1.41	1.37	1.60	1.49
Mooney Viscosity (LR 212°F.)	81	86	82	—	—
Mooney Scorch*	12	12½	16½	—	—
Physical Properties for 30 min. at 307°F. Cures.					
Tensile (psi)	3190	3360	3210	1910	2630
Modulus (300% E.)	880	920	1030	870	700
Modulus (500% E.)	1610	1660	1830	1780	2150
Elongation (%)	730	750	730	350	430
Hardness (Shore A)	70	77	85	86	95
Tear (lb./in)	730	440	480	450	660
Comp. Set (45 min. cure. Method B. 24 hrs. at 158°F.)	14.6	—	24.5	—	—
Properties After Air Oven Aging. 72 hrs. at 212°F. 30 min. at 307°F. Cure.					
Tensile (psi)	3430	2930	2810	—	—
Modulus (300% E.)	1240	1200	1380	—	—
Elongation (%)	660	600	560	—	—
Hardness (Shore A)	75	82	90	—	—
Immersion in A.S.T.M. No. 1 Oil. 72 hrs. at 212°F. 30 min. at 307°F. Cure.					
Tensile (psi)	2600	2910	2870	—	—
Modulus (300% E.)	900	940	1020	—	—
Elongation (%)	600	640	610	—	—
Hardness (Shore A)	63	64	63	—	—
Volume Increase (%)	7.9	8.5	8.4	—	—
Immersion in A.S.T.M. No. 3 Oil. 72 hrs. at 212°F. 30 min. at 307°F. Cure.					
Tensile (psi)	970	870	940	—	—
Modulus (300% E.)	640	540	560	—	—
Elongation (%)	430	430	440	—	—
Hardness (Shore A)	36	35	36	—	—
Volume Increase (%)	98.5	103	110	—	—
Immersion in Water. 7 Days at 212°F. 30 min at 307°F. Cure.					
Tensile (psi)	2770	3130	2480	—	—
Modulus (300% E.)	710	1030	650	—	—
Elongation (%)	640	630	640	—	—
Hardness (Shore A)	70	75	75	—	—
Volume Increase (%)	12.6	12.8	13.5	—	8.3

*Minutes to 5 point rise above minimum viscosity. S.R. 250°F.

TABLE XII. SOFT NBR ROLL COMPOUNDS (25 to 40 Durometer A)

	No.56	No. 57	No. 58	No. 59	No. 60
Hycar 1042	—	—	100	—	—
Chemigum N-6	—	—	—	100	—
Paracril OZO	100	100	—	—	100
Neophax A	25	15	20	40	20
Zinc Oxide	3	3	5	5	1
Hi-Sil 233	20	10	28	20	20
Calcene TM	50	25	—	20	—
Silene EF	3	3	—	—	—
Antioxidant 2246	1.5	1.5	2	1	1.5
Dyphos	—	—	—	—	3
TMTMS	0.3	0.3	0.5	—	—
TMTDS	—	—	—	0.5	0.5
MBTS	1.5	1.5	1	1.5	—
MBT	—	—	—	—	2
DPG	0.3	0.3	—	—	—
Sulfur	1.5	1.5	2.5	2	1.5
Dioctyl Phthalate	15	—	50	—	10
KP-555	15	15	15	40	—
Synthetic L-1	50	50	—	—	30
Turgum SB	—	—	—	—	20
Cumar P-10	—	—	5	15	—
Diethylene Glycol	—	—	—	—	2
Stearic Acid	1	1	1	1	0.75
Specific Gravity	1.23	1.18	1.12	1.15	1.13
Mooney Viscosity (LR 212° F.)	10	10	11	18	14
Mooney Scorch*	11½	10	>30	15½	5¾
Physical Properties:					
Optimum Cure	20 min. at 307°F.	20 min. at 307°F.	30 min. at 287°F.	20 min. at 307°F.	15 min. at 320°F.
Tensile (psi)	320	470	820	800	850
Modulus (300% E.)	100	120	180	230	210
Elongation (%)	960	860	690	670	830
Hardness (Shore A)	23	25	30	33	37
Tear (lb./in.)	30	60	70	60	90
Comp. Set, Method B Cure	45 min. at 307°F.	45 min. at 307°F.	60 min. at 287°F.	60 min. at 307°F.	—
24 hrs. at 158° F.	—	—	20.3	—	—
70 hrs. at 212° F.	94.2	81.4	—	73.7	—
Immersion in A.S.T.M. No. 1 Oil**					
Test Period	—	—	72 hrs. at 158°F.	72 hrs. at 212°F.	—
Hardness (Shore A)	—	—	38	25	—
Volume Decrease (%)	—	—	–28.6	–22.8	—
Immersion in A.S.T.M. No. 3 Oil**					
Test Period	—	—	72 hrs. at 158°F.	72 hrs. at 212°F.	—
Hardness (Shore A)	—	—	32	28	—
Volume Change (%)	—	—	–13.4	8.8	—
Immersion in SR-6 Test Fuel**					
Test Period	—	—	24 hrs. R.T.	72 hrs. R.T.	—
Hardness (Shore A)	—	—	25	25	—
Volume Increase (%)	—	—	18.6	40.1	—
Immersion in SR-10 Test Fuel**					
Test Period	—	—	24 hrs. R.T.	72 hrs. R.T.	—
Hardness (Shore A)	—	—	25	32	—
Volume Increase (%)	—	—	4.2	3.3	—
Immersion in Petroleum Naphtha**					
Test Period	—	—	24 hrs. R.T.	72 hrs. R.T.	—
Hardness (Shore A)	—	—	30	32	—
Volume Decrease (%)	—	—	–4.5	–2.4	—
Immersion in Acetates**					
Acetate	—	—	Ethyl	Butyl	—
Test Period	—	—	24 hrs. R.T.	72 hrs. R.T.	—
Hardness (Shore A)	—	—	15	22	—
Volume Increase (%)	—	—	123.0	127.9	—
Immersion in Toluol, 24 hrs. at R. T. 60 min. at 287° F. Cure					
Hardness (Shore A)	—	—	15	—	—
Volume Increase (%)	—	—	16.4	—	—
Immersion in Linseed Oil, 24 hrs. at R. T. 60 min. at 287° F. Cure					
Hardness (Shore A)	—	—	30	—	—
Volume Increase (%)	—	—	2.9	—	—
Immersion in Kerosene, 24 hrs. at R. T. 60 min. at 287° F. Cure					
Hardness (Shore A)	—	—	28	—	—
Volume Change (%)	—	—	–1.6	—	—

*Minutes to 5 point rise above minimum viscosity. S.R. 250°F. **Compound 58 cured 60 min. at 287°F. Compound 59 cured 40 min. at 307°F.

Table XIII—Medium Hardness NBR Roll Compounds
(40 to 60 Durometer A)

	No. 61	No. 62	No. 63	No. 64
Paracril BJ	90	—	—	—
Hycar 1042	—	85	85	100
Hycar 1312	10	15	15	—
Zinc Oxide	5	5	5	5
Hi-Sil 233	39	39	39	40
Calcene TM	—	—	—	28
Antioxidant 2246	2	2	2	2
TMTMS	0.5	0.5	0.5	0.5
MBTS	1	1	1	1.5
Sulfur	3	3.5	3	1.5
Dioctyl Phthalate	40	35	35	20
Cumar P-10	5	5	—	15
Stearic Acid	1	1	1	1
Specific Gravity	1.14	1.16	1.17	1.26
Mooney Viscosity (LR 212° F.)	17	29	18	46
Mooney Scorch*	>30	>30	>30	>30
Physical Properties for 45 min. at 287° F. Cure:				
Tensile (psi)	1220	1730	2030	2390
Modulus (300% E.)	310	460	420	290
Modulus (500% E.)	630	1110	940	—
Elongation (%)	650	580	660	810
Hardness (Shore A)	43	48	52	55
Tear (lb./in.)	90	100	130	230
Comp. Set (60 min. Cure. Method B, 24 hrs. at 158° F.)	—	—	15.5	—

* Minutes to 5 point rise above minimum viscosity. S.R. 250° F.

Table XIV—Medium High Hardness NBR Roll Compounds
(60 to 85 Durometer A)

	No. 65	No. 66	No. 67	No. 68
Hycar 1042	85	100	100	—
Chemigum N-6	—	—	—	100
Hycar 1312	15	—	—	—
Neophax A	—	10	—	—
Zinc Oxide	5	5	5	5
ELC Magnesium Oxide	—	—	—	5
Hi-Sil 233	46.5	50	60	70
Calcene TM	—	100	100	50
Antioxidant 2246	2	1	1	—
MBTS	1	1.5	1.5	1.5
TMTMS	0.5	—	—	—
TMTDS	—	0.5	0.5	—
DPG	—	—	—	0.75
Sulfur	3	2	2	1.75
Dioctyl Phthalate	25	25	25	—
Dibutyl Phthalate	—	—	—	20
Cumar P-25	—	10	10	10
Stearic Acid	1	1	1	0.5
Specific Gravity	1.21	1.42	1.44	1.41
Mooney Viscosity (LR 212° F.)	29	95	129	168
Mooney Scorch*	>30	21½	21¾	18½

Physical Properties:	No. 65 45 min. at	No. 66 45 min. at	No. 67 45 min. at	No. 68 45 min. at
Optimum Cure	287°F.	287°F.	287°F.	310°F.
Tensile (p.s.i.)	2850	1640	1680	2160
Modulus (300% E.)	610	710	890	1120
Modulus (500% E.)	1260	1360	1600	2060
Elongation (%)	680	570	520	530
Hardness (Shore A)	60	66	74	82
Tear (lb./in.)	210	210	250	400
Comp. Set (60 min. Cure. Method B, 24 hrs. at 158° F.)	18.9	—	—	—

Immersion Tests of Compound No. 65.
60 min. at 287° F. Cure.

Medium	Hardness (Shore A)	Volume Change (%)
A.S.T.M. No. 1 Oil, 72 hours at 158° F	56	—13.4
A.S.T.M. No. 3 Oil, 72 hours at 158° F	45	— 2.4
SR-6 Test Fuel, 24 hours at R.T.	37	27.9
SR-10 Test Fuel, 24 hours at R.T.	45	6.8
Petroleum Naphtha, 24 hours at R.T.	45	— 0.7
Ethyl Acetate, 24 hours at R.T.	18	119.0
Toluol, 24 hours at R.T.	28	14.6
Linseed Oil, 24 hours at R.T.	47	1.9
Kerosene, 24 hours at R.T.	50	8.6

* Minutes to 5 point rise above minimum viscosity. S.R. 250° F.)

Table XV—High Hardness NBR Roll Compounds
(85 to 95 Durometer A)

	No. 69	No. 70	No. 71	No. 72
Chemigum N-6	100	—	—	—
Hycar 1042	—	100	100	100
Zinc Oxide	5	5	—	5
ELC Magnesium Oxide	—	—	3	—
Hi-Sil 233	100	80	80	100
Solka Floc	—	10	10	—
MBTS	1.5	1.65	—	1.5
DPG	0.75	—	—	—
TMTDS	—	0.8	—	0.5
Sulfur	1.75	2	—	5
DiCup 40C	—	—	12.5	—
Triethanolamine	2	—	—	—
Dibutyl Phthalate	20	10	10	—
KP-555	—	—	—	10
Cumar MH 2½	10	10	7.5	10
Stearic Acid	0.5	2	1	3
Specific Gravity	1.31	1.30	1.31	—
Mooney Viscosity (LR 212° F.)	183	>200	>200	—
Mooney Scorch*	23½	26	3	—

Physical Properties:	45 min. at	30 min. at	30 min. at	45 min. at
Optimum Cure	310°F.	310°F.	310°F.	287°F.
Tensile (psi)	2540	3100	2270	3250
Modulus (300% E.)	1190	1840	—	—
Modulus (500% E.)	2240	—	—	—
Elongation (%)	560	450	260	210
Hardness (Shore A)	85	87	92	95
Tear (lb./in.)	460	270	160	500

* Minutes to 5 point rise above minimum viscosity. S.R. 250° F.

TABLE XVI—LOW HARDNESS THIOKOL ROLL COMPOUNDS
(12 to 36 Durometer A)

	No. 73	No. 74	No. 75
Thiokol FA	100	100	100
Neoprene WHV	30	—	—
Neoprene W	—	20	15
643-A Factice	20	—	20
Neophax A	10	45	—
Zinc Oxide	5	10	10
ELC Magnesium Oxide	1.2	0.87	0.6
Hi-Sil 233	19.5	19.5	39
Calcene TM	25	—	25
MBTS	0.35	0.4	0.35
DPG	0.15	0.1	0.15
NA-22	0.15	0.12	0.07
Mobilsol K	65	—	30
Circo Light Oil	—	35	—
Cumar P-25	30	—	10
Stearic Acid	0.5	1	0.5
Specific Gravity	1.28	1.30	1.44
Mooney Viscosity (LR 212° F.)	20	37	112
Mooney Scorch*	>30	>30	>30
Physical Properties for 60 min. at 287° F. Cures:			
Tensile (psi)	160	230	370
Modulus (300% E.)	—	130	200
Modulus (500% E.)	—	180	320
Elongation (%)	920	680	660
Hardness (Shore A)	12	25	36
Tear (lb./in.)	30	30	70
Immersion in A.S.T.M. No. 1 Oil, 72 hours at 158° F.**			
Hardness (Shore A)	30	33	53
Volume Decrease (%)	—26.9	—19.8	—16.4
Immersion in A.S.T.M. No. 3 Oil, 72 hours at 158° F.**			
Hardness (Shore A)	11	19	31
Volume Change (%)	7.4	32.1	—1.1
Immersion in SR-6 Test Fuel, 24 hours at R.T.**			
Hardness (Shore A)	9	17	21
Volume Increase (%)	49.6	62.5	23.1
Immersion in SR-10 Test Fuel, 24 hours at R.T.**			
Hardness (Shore A)	16	24	31
Volume Change (%)	17.9	3.0	—3.2
Immersion in Petroleum Naphtha, 24 hours at R.T.**			
Hardness (Shore A)	16	25	35
Volume Change (%)	—11.8	3.9	—0.3
Immersion in Ethyl Acetate, 24 hours at R.T.**			
Hardness (Shore A)	10	22	22
Volume Increase (%)	51.1	28.8	32.9
Immersion in Toluol, 24 hours at R.T.**			
Hardness (Shore A)	7	13	11
Volume Increase (%)	229.6	165.7	120.2
Immersion in Linseed Oil, 24 hours at R.T.**			
Hardness (Shore A)	13	23	32
Volume Change (%)	26.9	—0.2	—1.1
Immersion in Kerosene, 24 hours at R.T.**			
Hardness (Shore A)	18	24	32
Volume Change (%)	—12.1	2.2	—2.3

* Minutes to 5 point rise above minimum viscosity. S.R. 250° F.

** Compounds 73 and 75 cured 45 min. at 287°F. Compound 74 cured 60 min. at 287°F.

TABLE XVII—MEDIUM TO HIGH HARDNESS THIOKOL ROLL COMPOUNDS
(45 to 80 Durometer A)

	No. 76	No. 77	No. 78
Thiokol FA	100	100	100
Neoprene W	15	30	30
Neophax A	15	15	15
Zinc Oxide	10	10	10
ELC Magnesium Oxide	0.62	1.25	1.25
Hi-Sil 233	45	50	75
PBNA	1	1	1
MBTS	0.3	0.3	0.3
DPG	0.1	0.1	0.1
NA-22	0.12	0.12	0.12
Mobilsol N	30	10	10
Stearic Acid	1	1	1
Specific Gravity	1.43	1.49	1.51
Physical Properties for 60 min. at 287° F. Cure:			
Tensile (psi)	430	1000	950
Modulus (300% E.)	170	460	620
Modulus (500% E.)	290	750	920
Elongation (%)	800	720	510
Hardness (Shore A)	45	63	78
Tear (lb./in.)	80	260	260
Immersion in A.S.T.M. No. 1 Oil, 72 hours at 158° F. 45 min. Cure.			
Hardness (Shore A)	52	65	79
Volume Increase (%)	16.3	3.9	4.4
Immersion in A.S.T.M. No. 3 Oil, 72 hours at 158° F. 45 min. Cure.			
Hardness (Shore A)	30	42	60
Volume Increase (%)	7.9	26.4	17.7
Immersion in SR-6 Test Fuel, 24 hours at R.T. 45 min. Cure.			
Hardness (Shore A)	24	35	32
Volume Increase (%)	33.8	51.7	44.8
Immersion in SR-10 Test Fuel, 24 hours at R.T. 45 min. Cure.			
Hardness (Shore A)	36	40	52
Volume Increase (%)	4.5	12.2	10.2
Immersion in Petroleum Naphtha, 24 hours at R. T. 45 min. Cure.			
Hardness (Shore A)	30	42	62
Volume Increase (%)	2.5	2.3	2.7
Immersion in Ethyl Acetate, 24 hours at R.T. 45 min. Cure.			
Hardness (Shore A)	20	26	30
Volume Increase (%)	27.0	45.3	42.6
Immersion in Toluol, 24 hours at R.T. 45 min. Cure.			
Hardness (Shore A)	13	17	19
Volume Increase (%)	131.7	145.4	142.2
Immersion in Linseed Oil, 24 hours at R.T. 45 min. Cure.			
Hardness (Shore A)	35	42	60
Volume Increase (%)	—0.2	2.7	2.0
Immersion in Kerosene, 24 hours at R.T. 45 min. Cure.			
Hardness (Shore A)	31	55	69
Volume Increase (%)	4.4	4.8	4.6

mer prevents the buildup of electrostatic charges which make fabrics cling to other types of rolls. Four compounds in the medium to high hardness range—60 to 85—are shown in Table XIV, four high hardness—85 to 95—compounds in Table XV.

Where and How To Add Thiokol

Thiokol, because of its excellent resistance to ketones, aromatic solvents, esters and other plasticizers, finds wide use in the coating industry. Can coatings, furniture lacquers and finishes, quick drying inks—to mention a few of the liquids which are applied by rolls—require soft, low swelling, abrasion and tear resistant, non-black roll coverings.

Varnish and lacquer rolls require a Thiokol compound of about 30 Durometer hardness. Some of the compounds mentioned in Table XVI are satisfactory for this purpose. Thiokol compounds having higher Durometer hardnesses are listed in Table XVII.

It may be noted that all of the Thiokol compounds contain small amounts of neoprene. Each elastomer serves a distinct and separate function. The Thiokol polymer has better solvent resistance than neoprene, but loaded Thiokol compounds have very poor strength before cure and are difficult to handle during processing and building. Neoprene improves green strength and aids processing. The amounts used do not seriously lessen solvent resistance.

In mixing these compounds it is suggested that the Thiokol, factice and MBTS be blended together. Then, the neoprene should be broken down and the Thiokol-factice mixture be added *to the neoprene.* Fillers and softeners may be added when the two polymers are blended.

LITERATURE REFERENCE

(1) *Silene Bull.*, No. 2, p. 6, Columbia-Southern Chem. Corp. (1953).

Coming Soon . . .

Vulcanization of Polysiloxanes: Accelerated Electrons and High Temperature Ambients—By David J. Fischer and Vernon Flegel, Dow Corning Corp., Midland, Mich.

The purpose of this paper is to study individually and simultaneously the effect of intensity and temperature on the efficiency of vulcanization by accelerated electrons and to compare these treatments with the effects of equivalent Co^{60} irradiation.

Low Durometer Cast Urethane Elastomers—By H. L. Heiss, Mobay Chemical Co., New Martinsville, West Va.

Laboratory results show that catalysts and cure rate may determine potential for commercial usage.

Heat Resistant Properties of Fluorel Elastomer Under Extended Conditions—By D. A. Stivers, Don L. Peterson, and Galen R. Meier, Chemical Division, Minnesota Mining & Manufacturing Co., St. Paul, Minn.

Data showing heat resistance of a high-temperature, fluid-resistant elastomer, and how they can be used in predicting properties at intervals up to maximum life in the range 450°F. to 700°F.

Engineering Factors in Coating with Silicone Rubber for High Temperatures—By H. I. Silversher, R. C. Shaffer and R. A. Landry, Western Backing Corp., Culver City, Calif.

When glass cloth is combined with a silicone compound, the resulting product derives mechanical strength from the glass in addition to flexibility and protection from the rubber.

The Role of Carbon Black in the Thermal Oxidation of Polyolefins—By W. Lincoln Hawkins, Bell Telephone Laboratories, Murray Hill, N. J.

The ability, exhibited by many carbon blacks, to inhibit the free radical oxidation of polyolefins is dependent on the presence of certain reactive groups on the surface of the carbon particles. Heating in the presence of oxygen or sulfur increases the number of reactive groups to produce a much more effective antioxidant.

PLUS R/A SPECIAL INDUSTRY REPORT

Music for the Rubber Production Line

Pleasant listening may mean greater efficiency and higher output, according to recent psychological studies. The objective is to soothe the harried worker without putting him to sleep.

Compounding Elastomers for RUBBER —to— METAL Adhesion

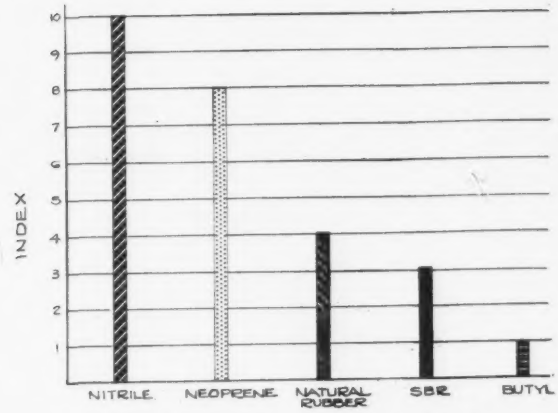

FIG. 1—Bondability index of common elastomers.

By William M. DeCREASE
Hughson Chemical Co.
Erie 6, Penna.

THE INTRODUCTION of organic adhesives for bonding elastomers to metal resulted in greater freedom for the rubber compounder in choosing compounding ingredients. Brass plating placed some very definite restrictions on the compounder, such as the type and amount of sulfur and sulfur-containing vulcanizing agents needed to achieve a proper chemical union between the copper in the brass and the sulfur in the elastomer compound.

A comprehensive treatment of brass plating as a means of adhering elastomers to metal is given by S. Buchan in his new book "Rubber to Metal Bonding" *(1)*. Mr. Buchan states: "Only certain brass compositions can be employed and to these particular brasses, only specific rubber qualities may be vulcanized if a consistently high level of adhesion is to be maintained." Thus, a brass deposit of a particular composition must be chosen for each rubber compound. This is usually established by a trial and error process.

High initial capital expenditures for brass plating equipment and the requirement of scrupulously clean metal units are some other criticisms leveled against brass plating by Buist, Meyrick and Stafford *(2)*.

Satisfactory bonding is now achieved with organic adhesives even in the complete absence of sulfur or sulfur-bearing compounds. Adhesives are also usually more tolerant of batch variations and high loadings of additives.

A rubber-metal bond formed with adhesives is not, however, completely independent of compounding ingredients. Optimum adhesion should not be expected unless some attention is given to certain general principles when compounding a rubber stock for bonding to metal or other substrates.

The scarcity of published literature on variations in the compounding of elastomers as it effects adhesion to metal is, in part, due to the lack of an accurate method for testing rubber-metal adhesion. The development of a new method which is particularly useful for measuring small differences has made possible this investigation; it will be described at the conclusion of this discussion.

Choosing the Right Elastomer

One of the first decisions to be reached when designing a rubber-containing bonded assembly is the choice of the elastomer. This is predicated on the expected use of the finished unit and, of course, on the economics involved. One consideration, too often lacking in this choice, is that property which we might label the "bondability" of the elastomer.

D. M. Alstadt classifies elastomers for adhesion considerations according to their polarity *(3)*. He defines polarity in terms of the presence or absence of strongly oriented electrical groups. By this classification, nitrile and neoprene rubber would be considered more polar than natural, SBR and butyl.

In general, it is true that nitrile and neoprene rubber compounds can be bonded to metal with greater ease than natural, SBR and butyl rubber, although they have similar physical properties. Whether this observable difference is due to a difference in polarity, however, has not been satisfactorily proven.

The term polarity often means different things to different people. It has been defined in terms of molecular symmetry, chemical reactivity, contact angle, solubility, etc. In this presentation we will avoid this

TABLE I—SOLUBILITY PARAMETERS OF COMMON ELASTOMERS

Elastomer	Bristow and Watson *(4)*	Gee *(5)*	Tobolsky *(6)*	Small *(7)*	Scott and Magot *(8)*	Range
Nitrile Rubber	8.7–10.3	9.4	9.4	9.25	9.5	8.7–10.3
Neoprene Rubber	8.6	8.2	9.2	9.4	9.25	8.2–9.4
Natural Rubber	8.1	7.9	7.9–8.4	8.1	8.35	7.9–8.4
Styrene Rubber	8.1	8.1	8.1–8.55	8.5	8.6	8.1–8.6
Butyl Rubber	7.8	—	7.7–8.5	7.7	8.05	7.7–8.5

controversy on polarity and assign a "bondability index" to describe the degree of bonding which can be anticipated in adhering the various elastomers to metal. This designation permits a relative value to be assigned to an elastomer, based on comparative bonding evaluation studies. It should be emphasized that it does not imply an inherent property of an elastomer.

We have found that nitrile rubber compounds are bonded to metal with greater ease than any other of the five most commonly used elastomers. By arbitrarily assigning a bondability index of ten to nitrile, we may make the relative assignment given in Figure 1—Nitrile 10, Neoprene 8, Natural 4, SBR 3, and Butyl 1. You will note that the greatest gap appears between neoprene and natural, showing that both nitrile and neoprene are much more easily bonded than natural, SBR and butyl.

Solubility Data Gives Parallel Results

Their solubility parameter is another property of these elastomers which results in the same grouping (Table I). Gauging the degree of swelling in various organic solvents, this property has been measured by a number of investigators *(3 to 7)*. Each individual study shows nitrile and neoprene with a higher solubility parameter than natural, SBR and butyl. Unfortunately, this relationship is the only one that could be made.

Frequently, the choice of elastomer is dictated by the end-use of finished items. Considerations such as cost, oil and ozone resistance usually limit the choice of elastomer to two or three—often, one. When a copolymer is involved, as is the case with nitrile, SBR and butyl, it must be decided which of the several commercially available monomer ratio systems will give the best combination of properties.

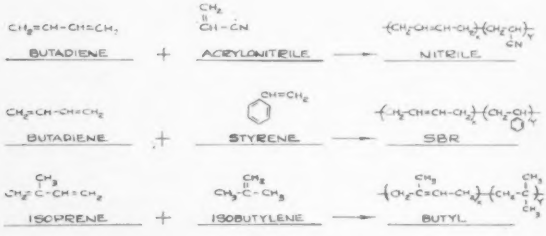

FIG. 2—Representation of reactions with copolymer elastomers.

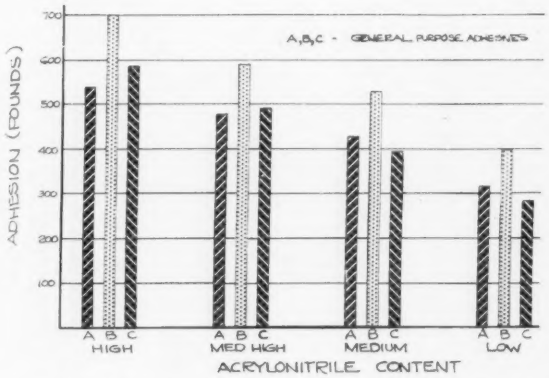

FIG. 3—Effect of monomer ration on adhesion of nitrile rubber.

The structure of these copolymer elastomers is illustrated in Figure 2. In bonding them to metal with an organic adhesive, the monomer ratio has been found to play a significant role. Just as the physical properties and environmental resistance of the vulcanizate are dependent upon the ratio of these monomers, adhesion is affected, though not necessarily to the same degree.

Figure 3 shows the effect on adhesion, as the acrylonitrile content in four nitrile compounds is varied from high to low. The only variable in these compounds is the ratio of monomers in the copolymer system. Three general purpose rubber-to-metal adhesives were used in this evaluation. A consistent relationship between acrylonitrile content and adhesion to metal was apparent.

Bond strength is at the highest level with a high acrylonitrile polymer and decreases going through the medium high, the medium and, finally, the low acrylonitrile to a bond strength which has been reduced approximately 50 per cent. In this study, it was found that Adhesive B (Chemlok 220) gave 20 to 25 per cent greater adhesion than either of the others tested.

The same three adhesives which we have just discussed in nitrile rubber bonding were used to bond several SBR compounds (Figure 4). Only the ratio of monomers—i.e., the ratio of bound styrene to butadiene—was varied in the three compounds involved in this study.

With all three adhesives, the best bond is achieved with the polymer having the lowest bound styrene, in this case 9 per cent. Two of the adhesives showed a

consistent trend of increasing adhesion with decreasing bound styrene; Adhesive B did not exactly follow this same trend. Although the highest value was observed when bonding the 9 per cent bound styrene compound, the intermediate, rather than the high styrene, gave the lowest results. It is difficult to explain this phenomenon. Possibly, the somewhat higher adhesion values achieved with this adhesive reduced the significance of the monomer ratio modification.

Assortment of Polymers Available

Butyl rubber is available in a variety of types. By varying the amount of isoprene in the copolymer, the mol percent unsaturation can be established at several levels. As the number of double bonds is increased from the lowest level of 0.8 mol per cent unsaturation to the highest concentration of 3.1 mol per cent unsaturation, a very significant increase in adhesion to metal can be observed (Figure 5).

In this chart, the three adhesives are labeled XYZ in order to differentiate between these special butyl adhesives and the three general purpose adhesives previously discussed. Bonding difficulties are particularly apparent at low isoprene levels. As the isoprene content is increased, differences in adhesion become smaller and smaller.

Although neoprene differs from the three preceding elastomers in reputedly being a homopolymer (chloroprene), several variations are again available. Neoprene polymers can be divided into two types; the sulfur-modified type, typified by GN, GNA and GRT; and the non-sulfur modified type, such as W, WRT and WHV. A good neoprene adhesive would satisfactorily bond neoprene compounds based on any of these polymers, and several products are available which will bond all of these polymers. Bonding the non-sulfur modified types is, however, usually more difficult than bonding the sulfur-modified (Figure 6).

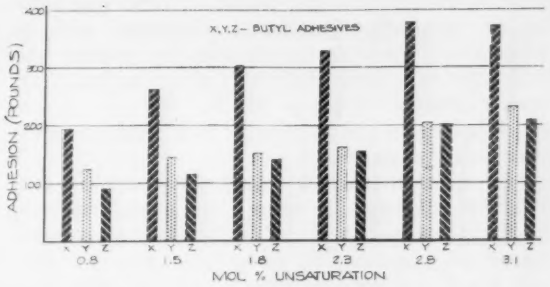

FIG. 5—Effect of monomer ratio on adhesion of butyl rubber.

This tendency becomes more pronounced as the overall performance of the bonding agent is reduced.

The rubber compounder is dependent upon nature in supplying him with natural rubber polymers. A recent statistical survey of latex blended from various trees showed a remarkably low difference between blends, even though the latex from individual trees varied greatly.

The introduction of synthetic polyisoprene rubber and the work being done on homopolymers of butadiene will unquestionably have a marked effect in many areas where natural rubber is now used. In our laboratories, some of these new homopolymers have been successfully bonded to metal with the same adhesives which satisfactorily bond natural rubber. Although a very limited amount of work has been done on these elastomers, it appears at this time that they offer no serious bonding problems.

Chemlok 607 is a silicone-based adhesive which bonds many of the "specialty elastomers" including silicones, fluoro-rubbers, chlorosulfonated polyethylene (Hypalon), and some urethanes. With the silicones, the bond to metal is, to a large extent, independent of polymer modifications; thus, the methyl, methyl-vinyl and methyl phenyl silicon gums, when

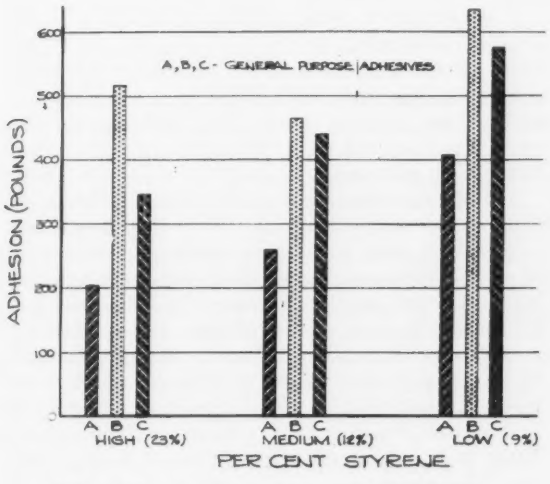

FIG. 4—Effect of monomer ration on adhesion of SBR.

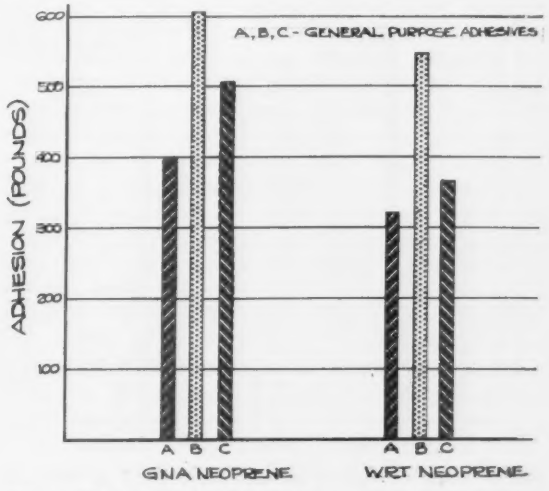

FIG. 6—Effect of polymer modification on adhesion of neoprene.

properly compounded, are bonded to metal with equal facility. Similarly, fluoronated elastomers such as Fluorel and Viton A are satisfactorily bonded with this adhesive. Three distinct Hypalon polymers are now available: Hypalon 20, 30, and 40. Again, no difference in the bonding of these Hypalon polymers to metal was noted.

The situation becomes more complex when considering urethane elastomers. As more and more urethane polymers become available, bonding differences are beginning to show up. There are polyether and polyester urethane elastomers, solids and castable systems. More work remains to be done in order to achieve a high level of adhesion to these various elastomers, and you will unquestionably be seeing some new and novel adhesive systems in the near future for bonding urethanes. At present, the urethane elastomers based on polyethers are somewhat more easily bonded than the polyester types.

Bonding Blended Polymers

Something should be said about bonding compounds which are made up of more than one elastomer. The blending of polymers for reasons of performance or cost is becoming quite common.

Generally, no bonding problems are encountered with compatible polymer blends of similar bondability index such as SBR and natural. By using our proposal of the bondability index of elastomers (Figure 1), we may make a useful generalization: if the bondability index of the elastomers varies by more than two units, some bonding problems may be encountered. Therefore, an adhesive should be chosen which satisfactorily bonds either polymer compounded alone.

For example (Figure 7), neoprene and SBR have a bondability index difference of 5. This blend is not satisfactorily bonded by Adhesive N, which is a recently developed one-coat adhesive for neoprene and nitrile compounds. This adhesive gives a high level of bond strength to neoprene, but has little or no affinity to SBR.

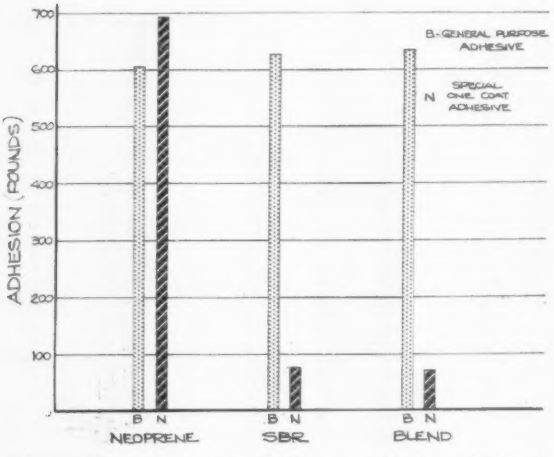

FIG. 7—Effect of type of adhesive on a blend of SBK and neoprene rubber.

SBR-neoprene blends can, however, be successfully bonded by using general purpose adhesives which will bond both the SBR and the neoprene compounds. Adhesive B demonstrates this property. There is probably a limit to the stretch of bondability index within which any one adhesive system can operate.

Now we will shift our attention from the polymer to the additives transforming it into a more useful item—the compounding ingredients. Since Charles Goodyear discovered that the addition of sulfur to natural rubber resulted in an improved elastomer, a tremendous number of chemical materials have been studied as compounding additives for various improvements of rubber compounds. In this study, no comprehensive effort was made to evaluate the effect on adhesion to metal of this imposing list of additives.

Our experience suggests that commonly used processing aids, vulcanizing agents, activators, retarders, antioxidants and antiozonants, used in practical amounts in compounding elastomers, play little if any role in adhesion to metal with organic adhesives. Thus, an elastomer may be compounded to a large extent for physical properties rather than for adhesion. Some other materials, however, have a more pronounced effect on adhesion than those mentioned, and require further comment.

Fillers Can Improve Adhesion

The additive usually compounded into a rubber stock in largest quantity is the filler. Although carbon black has traditionally been the filler for rubber, many other materials, such as silica, clays, and resins, are finding widespread use for this purpose. Returning to our former consideration of the bondability index, this property of an elastomer may be changed by the addition of fillers. The direction and magnitude of change is dependent upon the type and amount of filler, as well as on the original bondability index of the unfilled elastomer.

I would like to bring to your attention a recent Russian publication on rubber bonding *(8)*. This paper discusses adhesion of natural rubber and polychloroprene to metal, as affected by the addition of whiting and channel black. The adhesive in this study was described as a "solution containing chlorinated high polymers."

The Russian data show an increase in adhesion of filled versus unfilled stocks. With polychloroprene (Figure 8), this increase is essentially the same whether whiting or channel black are used, amounting to 150 per cent improvement in adhesion when 0 filler was compared with 30 parts filler. However, a very large difference in adhesion was observed between channel black and whiting used as fillers for natural rubber (Figure 9). Adhesion to unfilled natural rubber with this same adhesive was at a much lower level (about one tenth) than that of unfilled polychloroprene.

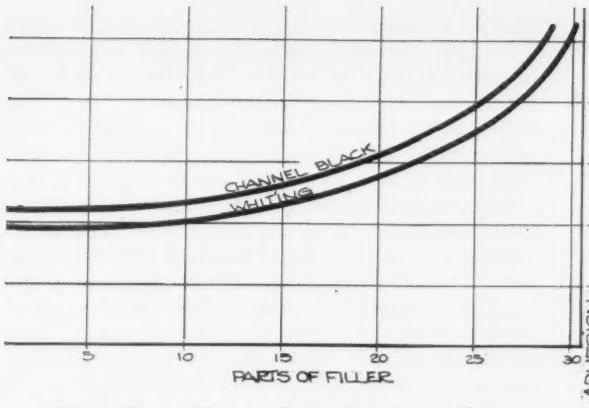

FIG. 8—Effect of fillers on adhesion of neoprene rubber.

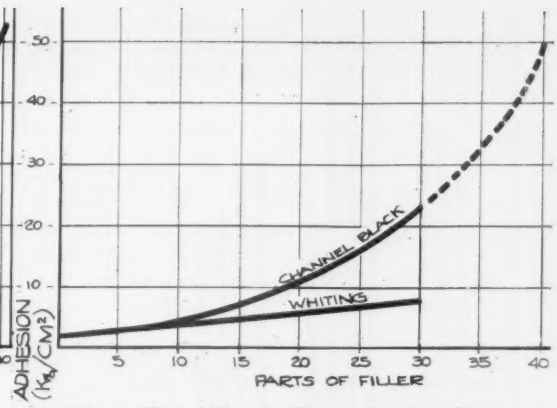

FIG. 9—Effect of fillers on adhesion of natural rubber.

The bond improvement by adding 30 parts of whiting was similar to that found by the addition of whiting to polychloroprene. The addition of 30 parts channel black to natural rubber increased adhesion by a factor of eight. An additional 10 parts of channel black raised the adhesion to the level obtained with 30 parts of the same filler in polychloroprene.

Using the concept of polarity, which we have previously discussed, we may conclude that:

¶ Adhesion of rubber-metal may be improved by adding fillers to the compound.

¶ Adhesion to "polar" elastomers was in this study independent of the polarity of the filler.

¶ Addition of a highly polar filler to a "non-polar" elastomer greatly enhanced its adhesion to metal.

These findings are consistent with those cited above *(3)*, and have been confirmed by recent work in our laboratories. Using our concept of bondability index, we may say that this property of a low index elastomer may be substantially increased by the addition of certain fillers, such as channel blacks. It should also be mentioned that channel blacks are more effective in this respect than are thermal or furnace blacks.

Avoid Waxy or Oily Ingreditents

As a general principle, it is advisable to avoid waxy or oily compounding ingredients which tend to migrate to the surface of rubber being bonded to metal. Thus, a much higher loading of a non-migratory oil may have a much less deleterious effect on adhesion than a lower concentration of an oil that has a tendency to "bloom" on the surface of rubber compounds. Some plasticizers suggested for low temperature performance are particularly harmful; for example, methyl acetyl ricinoleate and dibutoxy-ethoxyethyl formal.

It has been found that aromatic- and ester-type oils are generally less desirable than naphthenic or parafinic oils.

A recent study of bonding oil-extended SBR compounds to metal dramatically illustrates the influence on adhesion of compounding additional oil into oil-extended SBR polymer (Figure 10). The polymers involved contained 0, 25, 37½, and 50 parts of a naphthenic oil as a master-batch. Either a naphthenic or an aromatic oil was added to these polymers during compounding.

Findings of Oil-Extension Study

From this rather exhaustive study, several conclusions were apparent:

(1) Bonding oil-extended SBR polymers to metal is affected by the amount of oil in the polymer. In this study, 25 parts oil in the polymer resulted in adhesion as good or better than the control containing no oil; 37½ parts oil was slightly inferior, while 50 parts oil in the polymer resulted in lowest adhesion.

(2) When additional oil is added during compounding, the use of aromatic oil gave much lower adhesion values than an equal amount of naphthenic oil.

(3) A much higher oil loading can be tolerated—as far as adhesion to metal is concerned—if the additional oil is compounded into an SBR polymer containing less than 25 parts oil or no oil at all.

Our final concern for the effect of rubber compounding ingredients on adhesion considers various additives which have been observed to influence rubber-to-metal bonding. The first of these is Elastopar. This aromatic nitroso amine is sold by Monsanto which has found it useful as a chemical modifier for butyl rubber. It is said to improve a number of physical properties of butyl elastomers including resilience, modulus, abrasion resistance and low-temperature flexibility.

The use of up to ½ phr Elastopar has little effect on adhesion to metal. Beyond this point some deleterious effect is evident, becoming more pronounced when the concentration exceeds one part Elastopar per 100 parts butyl.

The second specific material which we will mention is one used with DuPont's fluoro-elastomer Viton A. During our investigation of bonding Viton A to

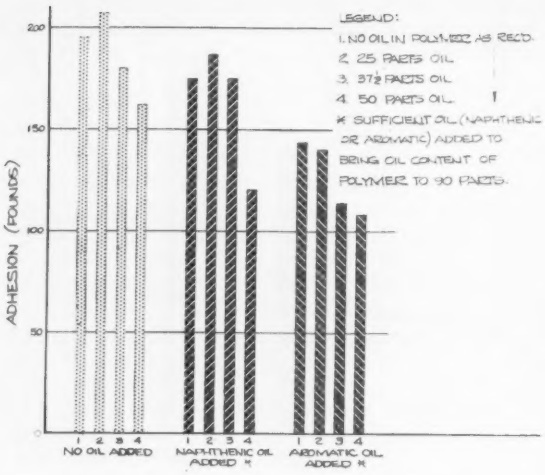

FIG. 10—Effect on adhesion of oil extending SBR.

metal, it was noted that Copper Inhibitor No. 65, a retarder-activator for Viton A, causes serious bonding problems. Fortunately, DuPont now recommends an alternate compound which, in fact, is reported to give improved vulcanizates. This compound is the diamine LD-214, reported to impart a good balance between processing safety and cure rate when used as a curing agent for Viton A. Thus, no activator-retarder is needed, as is the case with blocked diamine curing agents, such as Diak 1 and 2. LD-214 cured Viton A compounds have good adhesion to metal.

Whether the use of Copper Inhibitor No. 65 in other rubber compounds like natural, SBR and neoprene, as a metal complexing agent causes bonding problems is not known at this time.

One other compounding modification which affects rubber-to-metal adhesion was recently brought to our attention by the DuPont Company. They observed improved adhesion to metal of Adiprene L (DuPont's castable urethane elastomer) by increasing the concentration of curative in Adiprene L compounds. By increasing the amount of MOCA (4,4′-methylene-bis-2-chloroaniline) from the commonly used 11 phr to 13 phr, adhesion of rubber to metal was significantly improved, with only a slight modification of vulcanizate properties.

Our fourth consideration in this category is bonding polymethylol phenol resin-cured butyl compounds to metal. This type of resinous curative has been patented by the U. S. Rubber Company.

In order to speed up vulcanization of butyl rubber, using a polymethylol phenol resin, the use of a chlorinated activator has been found useful. We have encountered bonding difficulties when stannous chloride was used. By substituting a chlorinated polymer, such as DuPont's Hypalon, making chloride ions available with heat at a more controlled rate, bonding problems can be eliminated.

Chlorobutyl (Enjay MD-551) compounds may also be vulcanized with polymethylol phenol resins. With this new elastomer, no activator is necessary because the polymer supplies chlorine for activation of the cure. It might be mentioned at this point that chlorobutyl compounds appear to be bonded to metal with greater ease than do the conventional butyl compounds.

Our concluding comments on compounding ingredients have to do with silicone elastomers. Few of the bonding problems encountered with silicone rubber can be traced directly to compounding. In a few instances, excessive loadings of silicone oils, silicon dioxide fillers or certain additives such as Teflon powder have been responsible for bonding failures. Such compounding of silicones, however, is more the exception than the rule.

Bonding problems are more often associated with "gassing" or "blowing" at the silicone-metal interface due to the presence of peroxide catalysts. Gassing can be minimized by conforming to the recommendations of the silicone rubber supplier. For example, the proper initial cure of a thin section of silicone rubber catalyzed with benzoyl peroxide is about 10 minutes at 250° F., but 15 minutes at about 340° F. for cures with di-tertiary butyl-peroxide.

In addition, post-curing of bonded parts must be done step by step, using gradual heat increments to reach the final temperature. Such practices not only lessen adhesion problems, but turn out an improved vulcanizate.

In conclusion, I would like to mention the test method which was used in this study to measure rubber-to-metal adhesion *(9)*. Figure 11 schematically illustrates the manner in which rubber is bonded to the conical metal surfaces to make the test specimen. The most important characteristic of this unit is the tendency of the conical specimen to fail at the bond, rather than in the body of the elastomer, even when the adhesion is excellent. This apparently results from stress concentration in the vicinity of the bond.

As the specimen is stressed by pulling the conical metal parts away from each other, failure begins at the points of the cones and progresses down along the sides until it is complete. If the elastomer is cut away from the opposite end, one almost invariably finds that failure was almost complete at that end also.

Isochromatic lines obtained under load have been photographed *(10)*. It can be seen that the highest stress occurred at the cone ends and that minimum stress occurred at the outer boundaries of the elastomer. Although we have obtained no photograph of isochromatics during failure, the nature of the failure in the adhesion test specimen would indicate that the stress remains concentrated along the circle where the elastomer is peeling away from the metallic cone.

It should be pointed out that in a few instances the new test specimen has failed in the elastomer. Such failure can result when the elastomer has very poor tear strength and the adhesion is excellent. In most instances, however, the method has given highly satisfactory results and proven exceedingly sensitive.

This rubber-to-metal bond evaluation technique differs from current methods in several important respects:

(1) In contrast to rubber-metal peel adhesion tests, failure due to stress during testing occurs in the bond interface rather than within the body of the elastomer, as is often the case in peel tests. When failure occurs within the elastomer body, the only conclusion is: Adhesion is in excess of the tear strength of the elastomer under the test conditions. A forced interface failure, as provided by the new technique, permits comparative evaluation in this area of fair to excellent adhesion. Thus, greater reliance may be placed on the results—the actual number of pounds as a measure of the bond strength of a rubber-to-metal system.

(2) This method has shown greater reproducibility than any of the rubber-metal adhesion tests now in use.

(3) A close cluster of results among replicate samples is the rule rather than the exception. This is often not the case with butt joints or peel tests.

(4) These factors make possible a reliable comparison of rubber-to-metal adhesion, with more confidence in the degree of differences which often occur in practice. In fact, existing techniques do not accurately demonstrate some of the points listed above, such as the importance of monomer ratio in copolymer elastomers. This new method also promises to be very valuable to the adhesive user who must often make a choice of several adhesives which all *appear* to have equal adhesion to his rubber compounds.

To restate the major considerations which should be helpful when compounding an elastomer which is to be bonded to metal:

¶ Elastomers may be indexed according to the ease with which they are bonded to metal. The five most common elastomers have been assigned a "Bondability Index" giving the following values: nitrile—10, neoprene—8, natural—4, SBR—3, and butyl—1.

¶ The concentration of monomers in copolymer elastomers, has a pronounced effect on adhesion to metal. Adhesion of nitrile rubber is improved by high acrylonitrile. When bonding SBR compounds to metal, adhesion is enhanced by low bound styrene content. Finally, higher unsaturation butyl polymers bond to metal with greater ease than those having less double bonds; i.e., high isoprene butyl is favored.

¶ The sulfur-modified neoprenes (G Types) bond to metal with more ease than the non-sulfur modified (W Types) neoprenes. This effect may not be apparent for adhesives having exceptional affinity for neoprene bonding.

¶ Silicones, fluoro-rubbers, Hypalon and, to a lesser extent, urethane bonding is essentially independent of polymer modifications.

¶ When bonding blends of elastomers, an adhesive that satisfactorily bonds either elastomer alone should be used.

¶ In general, ester-type or highly aromatic plasticizers are more detrimental to adhesion than are naphthenic or parafinic.

¶ In bonding, a high-oil-extended SBR compound to metal, best results are obtained by compounding a naphthenic oil into an SBR polymer containing no more than 25 parts oil.

¶ Adhesion of various elastomers to metals are affected by certain miscellaneous additives. The following suggestions have been made: The Elastopar content in butyl rubber should be kept below one phr, ideally below 0.5 phr. Copper Inhibitor No. 65 in Viton A is detrimental to adhesion. LD-214 may be used with confidence. An increase from 11 to 13 phr of MOCA in compounding Adiprene will enhance adhesion to metal. The use of stannous chloride as an activator for resin-cure butyl may reduce the bond to metal, hence Hypalon activation is preferred. Gassing or blowing in silicone rubber must be minimized for proper adhesion to metal.

¶ Although the above mentioned principles appear to be valid for all rubber-to-metal adhesives, they are less pronounced when an adhesive of a versatile nature is used and changes in compounding are better tolerated.

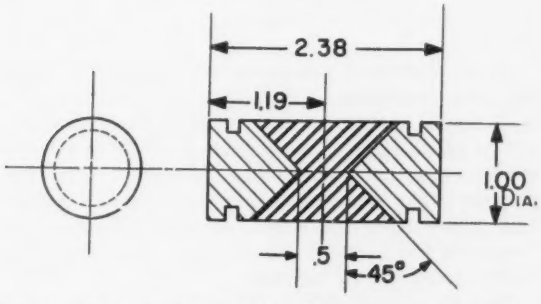

FIG. 11—Schematic diagram of bonding rubber to metal surface of test specimen.

ACKNOWLEDGEMENT

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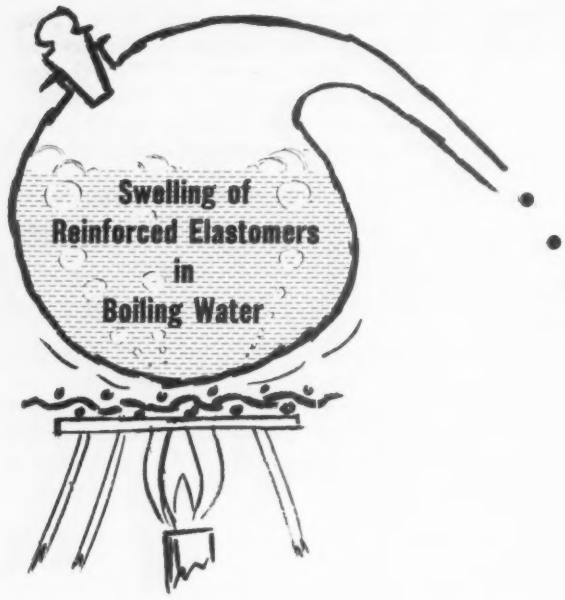

- *Studies show differential effect of fillers, depending on polymers used and electrolytic impurities present.*

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IN RECOMMENDING gaskets or seals for steam or hot water systems, the rubber technologist must decide on a composition that will give the best service for an extended period of time. In many cases recommendations are made on the basis of limited data—usually derived from short-term accelerated aging studies. The purpose of the present investigation was to obtain data that could be used in predicting more accurately the extended service life of a gasket or seal compound.

Data were obtained on gum stocks for control purposes. The influence of fillers on water absorption was noted; the absorption attributed to both polymer and filler was calculated. From these results, attempts were made to determine what characteristic factors influenced water absorption. Special emphasis was placed on the possible effect of small quantities of electrolyte present in polymer or filler.

All compositions studied in this program were compounded and cured in the laboratory, using conventional techniques. Milling was done on a 6 x 12-inch laboratory mill, after which 6 x 6 x 0.075-inch tensile sheets were cured in a steam press. Swelling and water absorption were determined on duplicate 1 x 2-inch samples, cut from the tensile sheets in accordance with ASTM Method D471-57T. For each specimen, weight and volume were determined before aging, using a Kraus-Jolly balance. The specimens were put into 38 x 200 mm test tubes, covered with distilled water, fitted with water-cooled condensers, and suspended in an oil bath maintained at 212° F. At the end of the aging period, weight and volume were again determined in accordance with the ASTM method.

Polymers and fillers were commercially available materials. The two butadiene-styrene copolymers, SBR-1500 and SBR-1503, respectively, represent a commonly used low-temperature polymer and a special wire-and-cable grade. The butyl rubber was of the type having maximum unsaturation. The neoprene was a nonsulfur modified type, the butadiene-vinylpyridine copolymer contained 25 per cent vinylpyridine, while the nitrile polymers represented both low and high acrylonitrile contents. The silicone gum was of the vinyl-modified type, and the acrylate-type polymer was a copolymer of ethyl acrylate and chloroethylvinylether.

Experimental Materials and Methods

Three silica fillers were investigated: a hydrated silicon dioxide, having an average particle size of 0.030 micron and a silicon-dioxide content of about 85 per cent; a hydrated silica, with a particle size of 0.022 micron and 87 per cent silicon dioxide, and an anhydrous silica, having a particle size of 0.015 to 0.020 micron and a silicon dioxide content of 99.0 to 99.7 per cent. Other fillers used were MPC, EPC, HAF, SAF, MT, conductive furnace blacks, hydrated calcium silicate, ELC magnesia, calcium carbonate and zinc oxide.

Water absorption was measured on samples before and after immersion. Values were corrected for polymer content, and reported as grams of water absorbed per cc of polymer. Vulcanizing agents were considered as polymers, since they ultimately enter the polymer chain, while zinc oxide was treated as a filler. The difference in the weight of water absorbed between the filled stocks and the gum stocks reflected water absorption by the filler.

Because of large density differences in fillers, water absorption due to the filler was calculated as volume

(in cc) of water absorbed per volume (cc) of filler. In many instances, water absorption of the filled stock, based on polymer volume, was lower than for the gum stock. This indicated that some fillers tend to suppress water absorption, which results in a negative absorption value. Swelling was determined by volume change in specimens.

In determining some of the factors that influence swelling and water absorption of vulcanizates, a number of gum stocks and filled vulcanizates were studied. Data show that certain swelling curves are consistently obtained for rubber stocks after long exposure to boiling water. Figure 1 illustrates these curves. For comparison, typical data on the swelling of rubber in oil are shown in Curve A, reaching a maximum in a relatively short time, after which the curve levels off. For water-rubber systems, swelling behavior in boiling water varies with polymer and filler types. Curve E shows a relationship that is linear: a constant but slow increase in the swelling with time; Curve B is almost linear, but the swelling occurs at a very much more rapid rate.

In some polymers with calcium-carbonate fillers, the swelling progresses at a lower rate for a number of hours, then there is a very rapid increase in the rate of swell (Curve C). Curve D shows results obtained with certain silica fillers in which the swelling increases very rapidly to a maximum, after which it decreases significantly and finally levels off. These curves indicate the fallacy of judging long-range performance by short-term swelling tests. These short-term data do not correlate with long-term tests, as can be noted in systems represented by Curves B and C; therefore, it is important that long-term aging tests be carried out for any application which requires prolonged exposure.

The recipes used to prepare gum stocks are shown in Table I. These recipes were kept as simple as possible, in order to simplify interpretation of the results. The action of boiling water on unfilled rubber vulcanizates is shown in Figure 2, as in Table II where the polymers are listed in order of increasing swell. It can be seen that nonpolar polymers which do not contain an appreciable amount of residual electrolyte impurity from manufacturing processes—i.e., silicone and Butyl 325—showed the least swell and water absorption. Brominated and chlorinated butyl, both with higher polarity than butyl rubber itself, were found to have considerably higher water pickup. The weakly polar neoprene and the highly polar acrylate polymers had greatly increased swelling and water absorption characteristics, compared with nonpolar materials.

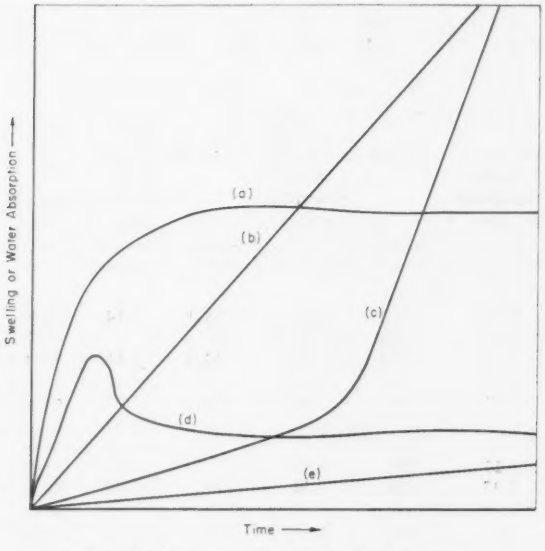


FIG. 1—Typical curves show effect of boiling water.

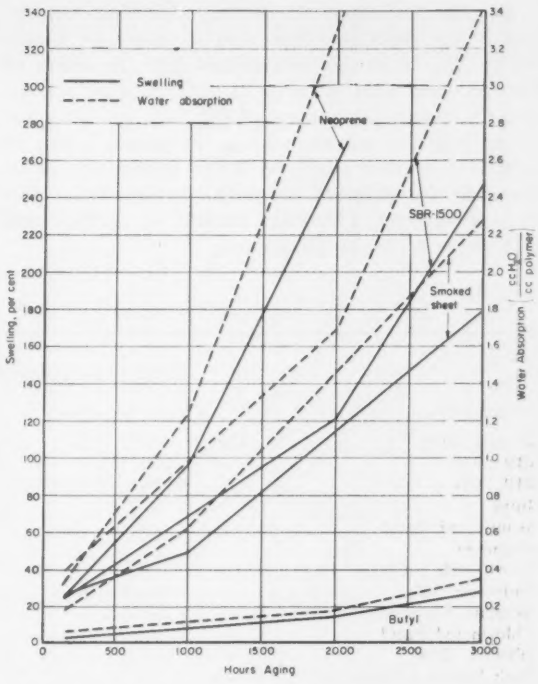


FIG. 2—Swelling and water absorption of four gum compositions were measured in boiling water.

Filler Effect Varies Greatly

Surprising results were obtained with the nitrile polymers, of low as well as high nitrile content, which had much lower swelling and water absorption than would have been anticipated from their polarity. No explanation seems to account for this very high resistance to swelling by boiling water. The effect of electrolyte impurity is definitely shown with SBR-1500, containing about 1 per cent sodium chloride from manufacture. This polymer picked up 8 times as much water as SBR-1503, a low electrolyte wire and cable grade, during equivalent exposure time. Only the nitrile gum reached maximum swelling, while all other gum stocks were continuing to swell at conclusion of testing.

The effect of fillers on swelling and water absorption of the individual polymers is shown in Tables III to XI. It would be expected that the effect of filler on water absorption varies, depending on impurities, the chemical structure of the filler and its interaction with the polymer. From the tables, it can be seen that a filler effect on water absorption varies markedly for different polymers, in regard to: (1) rate of swelling, (2) total amount of swelling and (3) shape of the swelling curve.

Table III and Figure 3 show the effect of several fillers on swelling and water absorption of SBR-1500. It can be seen that each filler acted quite differently. With hydrated silica, a maximum water absorption was reached very quickly in about 168 hours; after that it decreased. The stock containing hydrated calcium silicate rose in volume rapidly to maximum in 70 hours, then remained constant. When calcium carbonate was used as a filler, water absorption increased at a fairly rapid rate throughout the entire

TABLE I—GUM STOCK COMPOSITIONS

Polymer												
Smoked Sheet	100	—	—	—	—	—	—	—	—	—	—	—
SBR-1500	—	100	—	—	—	—	—	—	—	—	—	—
SBR-1503	—	—	100	—	—	—	—	—	—	—	—	—
Butyl	—	—	—	100	—	—	—	—	—	—	—	—
Brominated Butyl	—	—	—	—	100	—	—	—	—	—	—	—
Neoprene	—	—	—	—	—	100	—	—	—	—	—	—
Low Nitrile polymer	—	—	—	—	—	—	100	—	—	—	—	—
Philprene VP	—	—	—	—	—	—	—	100	—	—	—	—
Acrylate Polymer	—	—	—	—	—	—	—	—	100	—	—	—
Chlorinated Butyl	—	—	—	—	—	—	—	—	—	100	—	—
Silicone Gum	—	—	—	—	—	—	—	—	—	—	100	—
High Nitrile polymer	—	—	—	—	—	—	—	—	—	—	—	100
Filler												
Zinc Oxide	5	5	5	20	5	5	5	3	—	20	—	5
Stearic Acid	1	1.5	1.5	1	—	—	1	1.5	1	1	—	1
PBNA	1	1.5	1.5	—	—	1	—	—	—	—	—	—
Magnesium Oxide	—	—	—	—	—	4	—	—	—	—	—	—
Rio Resin	—	15	15	—	—	—	—	—	—	—	—	—
Benzothiazyl Disulfide	1	1.5	1.5	2	2	—	1	1.5	—	2	—	1
Tetramethyl Thiuram Disulfide	—	3.5	3.5	—	—	—	—	—	1	—	—	—
Para-Quinonedioxime	—	—	—	—	1	—	—	—	—	—	—	—
Sulfur	2.5	—	—	2	—	—	1.5	1.5	0.9	2	—	1.5
NA-22	—	—	—	—	—	0.5	—	—	—	—	—	—
Tellurium Diethyl Dithiocarbamate	—	—	—	2	—	—	—	—	—	2	—	—
Di-tert-Butyl Peroxide	—	—	—	—	—	—	—	—	—	—	0.8	—
Triethylene Tetramine	—	—	—	—	—	—	—	—	2.1	—	—	—
Curing Conditions												
Time (minutes)	40	30	30	30	30	30	40	30	30	30	20	40
Temperature (°F)	284	310	310	310	310	310	302	310	310	310	330	302

TABLE II—SWELLING AND WATER ABSORPTION OF GUM STOCKS

	Aged 168 hours		Aged 1000 hours		Aged 2000 hours		Aged 3000 hours		
Polymer	Swell (%)	Water Absorption (cc H_2O / cc polymer)	Swell (%)	Water Absorption (cc H_2O / cc polymer)	Swell (%)	Water Absorption (cc H_2O / cc polymer)	Swell (%)	Water Absorption (cc H_2O / cc polymer)	Hours to Maximum Swell
Silicone Gum	0.0	0.01	—	—	—	—	—	—	——
Butyl	2.7	0.05	8.6	0.10	14.7	0.18	28.0	0.34	5208+
Nitrile (low acrylonitrile)	4.9	0.06	8.7	0.12	10.9	0.16	—	—	2352
SBR-1503	8.0	0.11	10.3	0.11	16.1	0.19	33.6	0.43	3864+
Nitrile (high acrylonitrile)	10.1	0.13	—	—	—	—	—	—	——
Smoked Sheet	13.2	0.17	48.8	0.62	114	1.44	179	2.27	4200+
Philprene VP	13.6	0.16	—	—	—	—	—	—	——
Chlorinated Butyl	18.3	0.24	—	—	—	—	—	—	——
Neoprene	24.6	0.31	96.4	1.22	259	3.32	—	—	2520+
SBR-1500	25.9	0.38	68.7	0.97	120	1.70	246	3.48	4032+
Brominated Butyl	37.8	0.31	—	—	—	—	—	—	——
Acrylate	305	3.78	—	—	—	—	—	—	——

TABLE III—SWELLING OF FILLED SBR-1500 COMPOSITIONS

Filler:	50 phr Anhydrous Silica		50 phr Hydrated Calcium Silicate		60 phr Calcium Carbonate		50 phr EPC		50 phr Hydrated Silica (85%)		54 phr HAF		50 phr Hydrated Silica (87%)		50 phr MT	
Hours at 212°F.	Swell (%)	$\left(\frac{\text{cc } H_2O}{\text{cc pol.}}\right)$	Swell (%)	$\left(\frac{\text{cc } H_2O}{\text{cc pol.}}\right)$	Swell (%)	$\left(\frac{\text{cc } H_2O}{\text{cc pol.}}\right)$	Swell (%)	$\left(\frac{\text{cc } H_2O}{\text{cc pol.}}\right)$	Swell (%)	$\left(\frac{\text{cc } H_2O}{\text{cc pol.}}\right)$	Swell (%)	$\left(\frac{\text{cc } H_2O}{\text{cc pol.}}\right)$	Swell (%)	$\left(\frac{\text{cc } H_2O}{\text{cc pol.}}\right)$	Swell (%)	$\left(\frac{\text{cc } H_2O}{\text{cc pol.}}\right)$
70	14.1	0.23	22.7	0.43	8.1	0.10	8.5	0.13	35.4	0.65	12.3	0.21	37.0	0.66	13.2	0.24
168	21.4	0.35	19.7	0.34	14.3	0.23	12.3	0.22	43.7	0.85	14.2	0.33	38.5	0.70	16.7	0.31
336	17.9	0.35	20.3	0.37	17.2	0.26	14.9	0.27	38.9	0.71	—	—	—	—	—	—
504	15.3	0.27	19.7	0.37	22.1	0.36	17.8	0.31	27.8	0.52	—	—	—	—	—	—
672	14.1	0.25	21.1	0.41	27.6	0.65	—	—	23.9	0.44	—	—	—	—	—	—
840	13.7	0.25	18.9	0.38	35.7	0.59	—	—	—	—	—	—	—	—	—	—
1008	14.3	0.26	20.1	0.37	48.9	0.81	—	—	21.6	0.38	—	—	—	—	—	—
1176	13.8	0.26	20.0	0.37	63.0	1.08	—	—	20.9	0.35	—	—	—	—	—	—
1344	14.4	0.27	—	—	83.1	1.43	—	—	20.0	0.35	—	—	—	—	—	—
1512	13.6	0.27	—	—	103	1.81	—	—	19.8	0.35	—	—	—	—	—	—
1680	—	—	—	—	115	2.14	—	—	19.8	0.35	—	—	—	—	—	—
1848	—	—	—	—	133	2.31	—	—	—	—	—	—	—	—	—	—
2016	—	—	—	—	157	2.91	—	—	—	—	—	—	—	—	—	—
2184	—	—	—	—	177	3.26	—	—	—	—	—	—	—	—	—	—
2352	—	—	—	—	203	3.78	—	—	—	—	—	—	—	—	—	—
2520	—	—	—	—	229	4.26	—	—	—	—	—	—	—	—	—	—
2688	—	—	—	—	259	4.80	—	—	—	—	—	—	—	—	—	—
2856	—	—	—	—	281	5.21	—	—	—	—	—	—	—	—	—	—
3024	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
3192	—	—	—	—	326	6.06	—	—	—	—	—	—	—	—	—	—
3360	—	—	—	—	349	6.52	—	—	—	—	—	—	—	—	—	—
3528	—	—	—	—	378	7.05	—	—	—	—	—	—	—	—	—	—
3696	—	—	—	—	429	7.34	—	—	—	—	—	—	—	—	—	—

TABLE IV—SWELLING OF FILLED BUTYL COMPOSITIONS

Filler:	50 phr Hydrated Calcium Silicate		50 phr Hydrated Silica (85%)		54 phr MPC		50 phr Anhydrous Silica		50 phr EPC		60 phr Calcium Carbonate		100 phr ELC Magnesia		50 phr Hydrated Silica (87%)	
Hours at 212°F.	Swell (%)	$\left(\frac{\text{cc } H_2O}{\text{cc pol.}}\right)$	Swell (%)	$\left(\frac{\text{cc } H_2O}{\text{cc pol.}}\right)$	Swell (%)	$\left(\frac{\text{cc } H_2O}{\text{cc pol.}}\right)$	Swell (%)	$\left(\frac{\text{cc } H_2O}{\text{cc pol.}}\right)$	Swell (%)	$\left(\frac{\text{cc } H_2O}{\text{cc pol.}}\right)$	Swell (%)	$\left(\frac{\text{cc } H_2O}{\text{cc pol.}}\right)$	Swell (%)	$\left(\frac{\text{cc } H_2O}{\text{cc pol.}}\right)$	Swell (%)	$\left(\frac{\text{cc } H_2O}{\text{cc pol.}}\right)$
70	6.4	0.12	11.0	0.19	0.03	0.01	2.8	0.04	0.0	0.01	0.0	0.00	16.9	0.28	6.6	0.13
168	12.2	0.22	15.0	0.26	0.08	0.04	2.5	0.06	0.9	0.04	0.2	0.01	31.1	0.50	11.4	0.21
336	20.9	0.35	17.3	0.30	—	—	—	—	—	—	1.0	0.02	35.6	0.73	—	—
504	29.3	0.48	—	—	—	—	—	—	—	—	2.5	0.03	33.0	0.70	—	—
672	35.7	0.59	16.7	0.30	—	—	—	—	—	—	3.0	0.05	34.0	0.70	—	—
840	41.7	0.69	16.6	0.31	—	—	—	—	—	—	6.7	0.11	33.8	0.72	—	—
1008	45.3	0.74	16.9	0.30	—	—	—	—	—	—	—	—	35.0	0.72	—	—
1176	49.6	0.76	17.3	0.30	—	—	—	—	—	—	—	0.20	—	—	—	—
1344	48.8	0.78	16.8	0.28	—	—	—	—	—	—	14.4	0.25	—	—	—	—
1512	—	—	—	—	—	—	—	—	—	—	17.3	0.28	—	—	—	—
1680	47.6	0.86	—	—	—	—	—	—	—	—	11.6	0.19	—	—	—	—
1848	45.4	0.74	—	—	—	—	—	—	—	—	18.2	0.31	—	—	—	—
2016	43.6	0.70	—	—	—	—	—	—	—	—	—	—	—	—	—	—
2184	—	—	—	—	—	—	—	—	—	—	27.5	0.48	—	—	—	—
2352	—	—	—	—	—	—	—	—	—	—	31.3	0.51	—	—	—	—
2520	—	—	—	—	—	—	—	—	—	—	34.7	0.57	—	—	—	—
2856	—	—	—	—	—	—	—	—	—	—	38.5	0.62	—	—	—	—
3024	—	—	—	—	—	—	—	—	—	—	43.4	0.70	—	—	—	—

exposure period, until the sample had absorbed water beyond the measuring equipment's range, when it had reached over 400 per cent swell. Carbon black stocks had least over-all swell, increasing rapidly, then leveling off.

Comparable data for butyl are shown in Table IV and Figure 4, showing varying behavior of fillers. The gum stock swelled very slowly, but at a linear rate. With hydrated silica (85 per cent), the maximum water absorption was obtained quickly, then the curve leveled off. Hydrated calcium silicate produced an increase in water absorption to maximum in about 1600 hours, followed by a significant decrease. The composition containing ELC magnesia quickly absorbed water to maximum, followed by a decrease in water absorption.

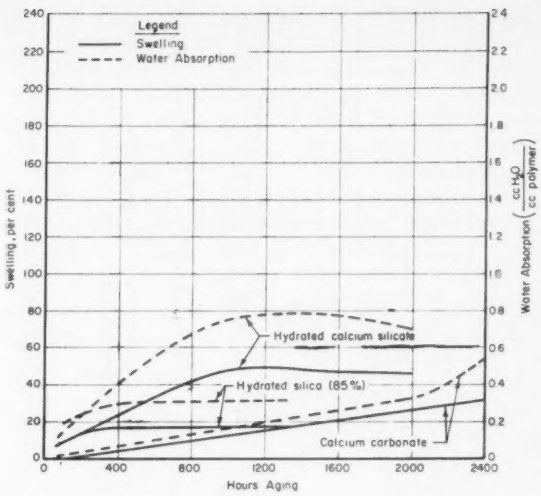


FIG. 4—Relative effects of three fillers is traced on swelling and water absorption data for butyl rubber.

Some Fillers Confound Expectations

The effect of fillers on styrene rubber, neoprene, nitrile, vinyl pyridine, brominated butyl and chlorinated butyl, is shown in Tables V to IX. These data indicated that the effect of certain fillers was opposite to expectations. This relation can be seen better if results are compared for a single filler in different polymers, as in Figures 5 to 7.

Figure 5 shows the effect of hydrated calcium silicate on three polymers. Neoprene, having a high degree of swell as a gum stock, reached maximum within 70 hours with filler, after which the swelling decreased, finally leveling off at a low value of about 15 per cent. By contrast, both butyl and SBR-1503, with very low water absorption in the gum stock, increased in swell to a much higher degree, before leveling off when hydrated calcium silicate was present. SBR-1503 swelled over 100 per cent, butyl attaining approximately 45 per cent. Water absorption seems to depend on the presence of electrolyte in the filler.

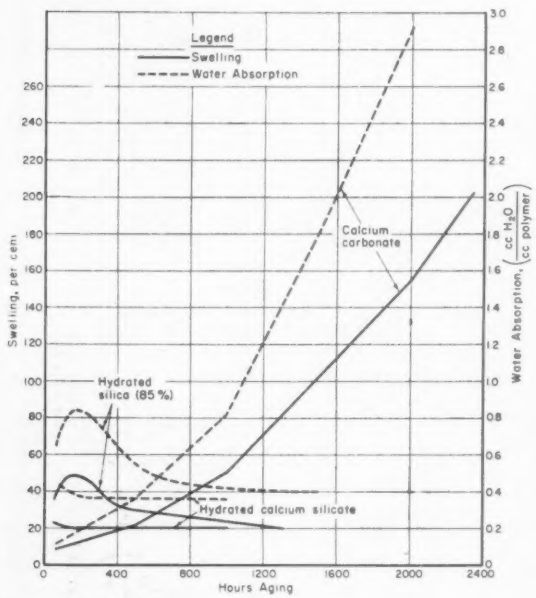


FIG. 3—Curves show effect of fillers on swelling and water absorption of SBR-1500.

Figure 6 shows the effect of using hydrated silica (85 per cent) in three different polymers. The two styrene polymers reached maximum water absorption and swelling in 168 hours, after which the water absorption and swell decreased markedly, finally leveling off at a very low value. No maximum effect was apparent for butyl: water absorption increased slowly, leveling off at a very low value on 600 hours' aging.

The effect of using calcium carbonate with SBR-1500 and butyl is shown in Figure 7. With SBR-1500, the calcium carbonate caused a steady increase in water absorption which increased in rate as the aging time is increased. With butyl, there is almost a linear increase of water absorption with time.

The water absorption values shown in Figures 5 to 7 are a combined effect of the polymer and the filler. To study the filler effect more thoroughly, the amount of water absorbed by it was calculated, by determining water absorbed by the swollen vulcanizate and subtracting that absorbed by the polymer. Because of density differences in the fillers, the water absorbed per cc of filler was calculated in all cases. Table X summarizes the results of this study. From this table, it can first be noted that there are positively and negatively acting fillers; i.e., some fillers increase water absorption while others reduce it.

In all cases but one, carbon black fillers decreased water absorption, furnace black to a greater extent than channel black. Calcium carbonate, anhydrous silica and hydrated calcium silicate acted as a positive or a negative filler, depending upon the polymer and aging time. Other fillers always had a positive effect. Hydrated silica (87 per cent), which is reported by the manufacturer to contain less electrolyte impurity than hydrated silica (85 per cent), generally showed

less water absorption. Much of this seems due to impurity, since anhydrous silica with little impurity generally has a negative effect on water absorption.

At the beginning of this program, it was anticipated that the effect of a particular filler would be independent of the polymer in which it was used. Table X shows this not to be true. The amount of water absorbed, by unit volume of filler, varied with the polymer used. This held for short-term, 168-hour tests, as well as long-term exposure. Such an unexpected effect may be related in some way to differences in the wetting of fillers by different polymers.

In some types of swelling—with oils, for example—the effect of cure time is significant. In order to determine whether this effect could also be found with water swelling, two SBR-1500 compositions—one gum and one black filled—were cured for varying times, and evaluated. Data are given in Table XI. For the gum stock, there was very little difference in swell or water absorption between the 30 and 60-minute cure. In the carbon black-filled composition, the 15-minute cure, which was a definite undercure, swelled and absorbed more water than 30 and 60-minute cures. These results indicate that there is a significant difference if the composition is undercured; but, if there is no undercure, the effect of cure time is very small.

TABLE V—SWELLING OF FILLED SBR-1503 COMPOSITIONS

Filler:	50 phr Hydrated Calcium Silicate		50 phr Hydrated Silica (85%)		54 phr MPC		50 phr Anhydrous Silica		50 phr EPC		60 phr Calcium Carbonate	
Hours at 212° F.	Swell (%)	$\left(\frac{cc\ H_2O}{cc\ polymer}\right)$	Swell (%)	$\left(\frac{cc\ H_2O}{cc\ polymer}\right)$	Swell (%)	$\left(\frac{cc\ H_2O}{cc\ poly.}\right)$	Swell (%)	$\left(\frac{cc\ H_2O}{cc\ poly.}\right)$	Swell (%)	$\left(\frac{cc\ H_2O}{cc\ poly.}\right)$	Swell (%)	$\left(\frac{cc\ H_2O}{cc\ poly.}\right)$
70	20.5	0.40	24.7	0.38	2.1	0.07	1.8	0.02	1.5	Nil	2.3	Nil
168	43.5	0.81	29.3	0.54	1.9	0.05	2.4	0.03	2.6	0.04	4.4	0.05
336	70.8	1.30	22.3	0.43	—	—	—	—	—	—	—	—
504	87.7	1.63	19.7	0.36	—	—	—	—	—	—	—	—
672	98.0	1.79	12.7	0.24	—	—	—	—	—	—	—	—
840	109	2.00	11.8	0.21	—	—	—	—	—	—	—	—
1008	115	2.10	11.1	0.20	—	—	—	—	—	—	—	—
1176	119	2.19	13.1	0.23	—	—	—	—	—	—	—	—
1344	111	2.04	—	—	—	—	—	—	—	—	—	—
1512	102	1.84	9.5	0.16	—	—	—	—	—	—	—	—
1680	107	1.95	9.5	0.17	—	—	—	—	—	—	—	—
1848	—	—	10.4	0.19	—	—	—	—	—	—	—	—
2016	117	2.15	—	—	—	—	—	—	—	—	—	—
2184	105	1.94	—	—	—	—	—	—	—	—	—	—
2352	108	1.97	—	—	—	—	—	—	—	—	—	—

TABLE VI—SWELLING OF FILLED NITRILE (LOW ACRYLONITRILE) COMPOSITIONS

Filler:	40 phr EPC		50 phr Hydrated Calcium Silicate		50 phr Calcium Carbonate	
Hours at 212° F.	Swell (%)	$\left(\frac{cc\ H_2O}{cc\ polymer}\right)$	Swell (%)	$\left(\frac{cc\ H_2O}{cc\ polymer}\right)$	Swell (%)	$\left(\frac{cc\ H_2O}{cc\ polymer}\right)$
70	2.7	0.06	35.0	0.61	3.2	0.06
168	2.7	0.05	41.7	0.70	6.7	0.11

TABLE VII—SWELLING OF FILLED NEOPRENE COMPOSITIONS

Filler:	50 phr Hydrated Calcium Silicate		50 phr Hydrated Silicate (85%)		50 phr HAF		50 phr Hydrated Silica (87%)	
Hours at 212° F.	Swell (%)	$\left(\frac{cc\ H_2O}{cc\ polymer}\right)$	Swell (%)	$\left(\frac{cc\ H_2O}{cc\ polymer}\right)$	Swell (%)	$\left(\frac{cc\ H_2O}{cc\ polymer}\right)$	Swell (%)	$\left(\frac{cc\ H_2O}{cc\ polymer}\right)$
70	27.3	0.50	16.7	0.33	6.0	0.13	15.9	0.26
168	25.4	0.46	16.4	0.30	9.2	0.20	14.1	0.33
336	19.4	0.35	—	—	6.9	0.19	—	—
504	16.8	0.29	—	—	8.8	0.22	—	—
672	15.8	0.25	—	—	—	—	—	—
840	14.6	0.24	—	—	—	—	—	—
1008	15.5	0.22	—	—	—	—	—	—
1176	13.9	0.20	—	—	—	—	—	—
1344	14.2	0.19	—	—	—	—	—	—
1512	12.9	0.17	—	—	—	—	—	—

TABLE VIII—SWELLING OF FILLED PHILPRENE VP COMPOSITIONS

Filler:	46.6 phr Hydrated Calcium Silicate		30 phr Hydrated Silica (85%)		40 phr Anhydrous Silica	
Hours at 212° F.	Swell (%)	$\left(\frac{\text{cc } H_2O}{\text{cc polymer}}\right)$	Swell (%)	$\left(\frac{\text{cc } H_2O}{\text{cc polymer}}\right)$	Swell (%)	$\left(\frac{\text{cc } H_2O}{\text{cc polymer}}\right)$
70	46.6	0.75	29.2	0.58	4.6	0.09
168	66.0	1.01	43.6	0.84	4.8	0.09
336	—	—	45.7	0.84	—	—
504	—	—	48.4	0.91	—	—
672	—	—	52.1	0.99	—	—
840	—	—	57.0	1.09	—	—
1008	—	—	61.5	1.20	—	—
1176	—	—	65.5	1.23	—	—
1344	—	—	69.8	1.31	—	—
1512	—	—	71.4	1.36	—	—
1680	—	—	76.2	1.43	—	—
1848	—	—	69.3	1.36	—	—
2016	—	—	78.5	1.32	—	—
2184	—	—	83.0	1.55	—	—
2352	—	—	84.3	1.60	—	—
2520	—	—	88.1	1.67	—	—
2688	—	—	91.8	1.74	—	—
2856	—	—	94.6	1.80	—	—
3024	—	—	96.9	1.87	—	—
3192	—	—	99.3	1.88	—	—
3360	—	—	107	2.01	—	—

TABLE IX—SWELLING OF FILLED COMPOSITIONS FROM MISCELLANEOUS POLYMERS

Polymer:	Smoked Sheet		Brominated Butyl		Chlorinated Butyl		Chlorinated Butyl	
Filler:	50 phr EPC		50 phr HAF		50 phr HAF		50 phr Hydrated Silica (85%)	
Hours at 212° F.	Swell (%)	$\left(\frac{\text{cc } H_2O}{\text{cc polymer}}\right)$	Swell (%)	$\left(\frac{\text{cc } H_2O}{\text{cc polymer}}\right)$	Swell (%)	$\left(\frac{\text{cc } H_2O}{\text{cc polymer}}\right)$	Swell (%)	$\left(\frac{\text{cc } H_2O}{\text{cc polymer}}\right)$
70	5.0	0.06	13.4	0.25	6.2	0.12	17.5	0.33
168	6.9	0.11	24.0	0.43	10.2	0.20	26.9	0.47

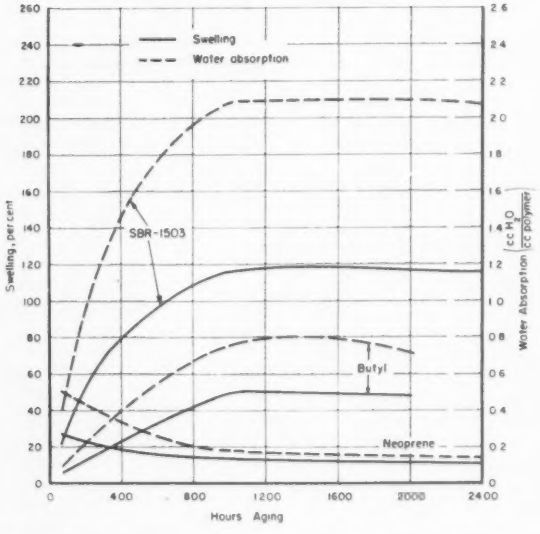


FIG. 5—Effect of three polymers on swelling and water absorption of compositions containing hydrated calcium silicate, is shown in these curves.

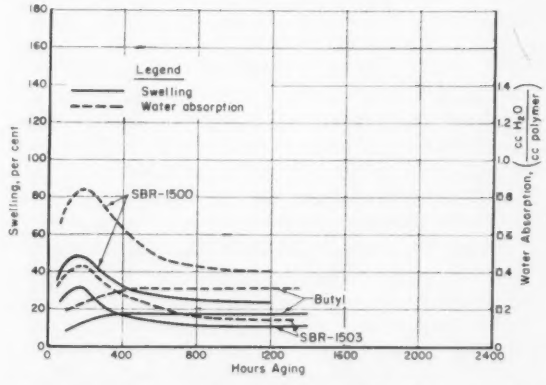


FIG. 6—Effect of three polymers was compared in data on swelling and water absorption of compositions containing hydrated silica (85 per cent).

Summary and Conclusions

Silicone and butyl elastomers exhibit the least swelling and water absorption. In general, increasing either the polarity of the rubber or its electrolyte impurity

content, increases swelling and water absorption. The acrylate polymer was found to have the highest water absorption of any material evaluated, probably partly due to the amine curing agents utilized in its vulcanization. Nitrile polymers, with low or high acrylonitrile content, showed surprisingly little swelling, considering their polarity. It is interesting to note, however, that fillers, which produce high swell in non-water-absorbing polymers, decrease swell in high-swelling rubbers such as neoprene and SBR-1500.

The data further point to the presence of an electrolytic impurity in either polymer or filler as a major cause of high water absorption. This is shown by the difference between such polymers as SBR-1500, swelling approximately 25 per cent, and SBR-1503 with only 5 per cent. The former contains approximately 1.5 per cent soluble ash, compared with the less than 0.1 per cent of SBR-1503.

TABLE XI—EFFECT OF CURE TIME ON SWELLING AND WATER ABSORPTION OF SBR-1500

	Per Cent Swell		Water Absorption ($\frac{cc\ H_2O}{cc\ polymer}$)	
Hours Aging:	70	168	70	168
Gum Stock				
Cure Time (min. at 302° F.)				
30	24.9	30.2	0.31	0.38
60	22.0	28.2	0.27	0.35
Carbon Black Filled				
Cure Time (min. at 302° F.)				
15	12.7	15.8	0.21	0.26
30	9.9	12.9	0.16	0.22
60	8.3	10.1	0.14	0.17

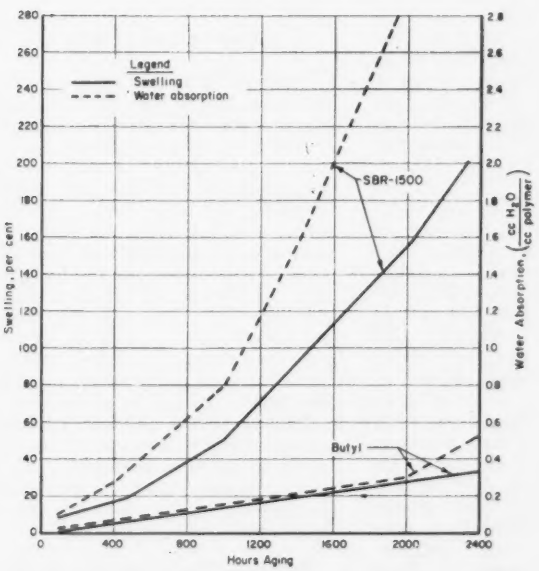


FIG. 7—These curves trace effect of two polymers on swelling and water absorption of compositions containing calcium carbonate.

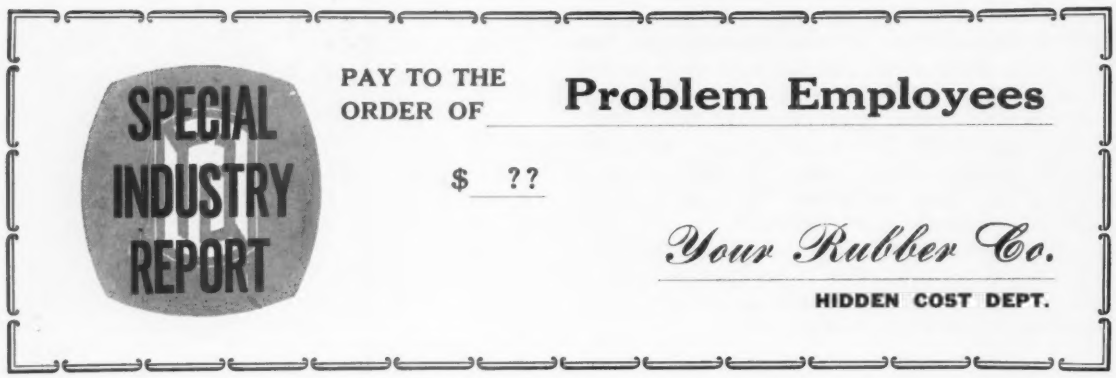
TABLE X—WATER ABSORPTION OF FILLERS IN POLYMER VULCANIZATES

Water Absorption (cc H_2O/cc filler)

Polymer:	Butyl		SBR-1500		SBR-1503		Neoprene		Nitrile	Brominated	Smoked	Philprene VP
Aging Time, hours: Filler	168	Extended	168	Extended	168	Extended	168	Extended	Low Acrylonitrile 168	Butyl 168	Sheet 168	168
MPC Black	—0.03	—	—	—	—0.03	—	—	—	—	—	—	—
EPC Black	—0.04	—	—0.43	—	—0.09	—	—	—	—0.02	—	—0.15	—
HAF Black	—	—	—0.14	—	—	—	—0.25	—	—	—0.36	—	—
SAF Black	—	—	—	—	—	—	—	—	—	—	—	—
MT Black	—	—	0.11	—	—	—	—	—	—	—	—	—
Conducting Channel Black	—	—	—0.30	—	—	—	—	—	—	—	—	—
Anhydrous Silica	0.05	—	—0.03	—3.45 (1512)*	—0.13	—	—	—	—	—	—	—
Hydrated Silica (85%)	0.65	0.59 (1176)*	1.72	—	1.48	0.22 (1848)*	0.04	—	—	—	—	—0.33
Hydrated Silica (87%)	0.68	—	1.01	—	—	—	—0.20	—	—	—	—	—
Hydrated Calcium Silicate	0.72	2.18 (1680)*	0.61	—2.38 (1176)*	2.24	5.82 (2352)*	0.06	—4.93 (1512)*	2.13	—	—	2.98
Zinc Oxide	—	—	—	—	0.46	—	—	—	—	—	—	—
ELC Magnesia	1.66	1.65 (1008)*	—	—	—	—	—	—	—	—	—	—
Calcium Carbonate	—0.07	—	—0.47	—	—0.06	—	—	—	0.21	—	—	—

* Number of hours aging to maximum or minimum water absorption.

How Much Are Problem Employees Costing You?



By Auren URIS
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► EVERY COMPANY has one or more problem employee on its roster. Few are clear on what to do about them. Rubber plants are no exception.

Even the experts are confused. Read what some of them say, and you get the idea that the problem employee is the non-conformist, the offbeat individual who speaks, thinks or acts differently from his co-workers. Or, according to some, he is a neurotic, maladjusted individual.

Actually, an employee might be any of these, and still not be a problem. The problem employee has one and only one identifying mark: *he causes loss to your company*. If there is no loss or damage, you simply don't have a bona fide case, regardless of the employee's appearance, behavior, or what have you.

Identifying the Trouble-Makers

The loss caused by a problem worker may come about in three different ways. In any single instance, one or more of these may apply:

(1) He underperforms in his job . . . He produces less work than others, or turns out excessive bad work. One way or another, he fails to measure up to the performance standards set for him.

(2) He interferes with the performance of others . . . Take the case of the compulsive talker. He constantly makes the rounds, cutting into the productivity of his team mates. The work they don't produce, the attention to the job they fail to give, are the source of losses to your firm.

(3) He does damage to the company . . . This may include intangible loss. A constantly unpleasant telephone operator, a loud-mouth truck driver, do harm to the image of your company. The fact that this kind of damage is intangible does not diminish actual losses that eventually may result.

Intangibles Can Be Costly

Losses that stem from the problem employee group are measured in unproductive time, waste, errors, rising reject percentages and falling production, and safety performance.

Intangible losses may far outweigh even the substantial money loss. Customer dissatisfaction, tarnished public relations, depressed morale, may not be easy to assess. But, to the manager with long range perception, the intangible damage spells ultimate losses that can threaten profitability, and even survival of a business.

A list of problem types may be almost unending; however, grouped according to source of difficulty, they tend to fall into four basic categories: First is the employee with health complaints—the man with the bad back or the one who catches cold easily. Also included is the old timer approaching retirement age, with failing physical resources.

Next are the individuals whose abnormal attitudes make them problems. Take the case of employee Joe R. He feels he has a "perfect right" to chat during working hours. Any attempt on the part of his supervisor to limit his verbosity is met with resentment. The supervisor will be told his efforts to stem the work-interfering chatter are anything from unfair to un-American. Also in this class is the overly-ambitious employee who feels that the world is his oyster and wants to crack it wide open regardless of who suffers.

Third are problem employees who have been created by circumstances in their work situation. The trouble may stem from an uncongenial fellow-worker, a physical working condition, or any one of the dozens of elements that make up an individual's work scene. Some aspect of his job rubs him the wrong way. Result: performance suffers.

How To Lose Friends

Finally, a certain percentage of people cause losses because of personality factors: the hostile individual, for example, whose aggressive or destructive feelings are turned loose to do damage on the job. The overly-dependent individual belongs to this group, too. Generally, the nature of the loss he causes is different from that caused by the hostile person. He often does his damage by requiring excessive supervisory attention. His under-par performance may take the form of mediocre and unimaginative carrying out of routine assignments, avoiding any task that is new or challenging.

Dealing with a problem employee usually requires action to change an aspect of his work environment. The supervisor may attempt to remove the employee from the problem category by bringing about changes in:

Behavior—The perennial latecomer, for example, can frequently be "cured" by making it clear that he must con-

form to the same regulations that others do.

Attitude—The employee who causes trouble by a chip on his shoulder may have his pugnaciousness diminished by an understanding supervisor who provides the insight that will help him understand that this attitude is self-defeating.

Situation—The employee who has become a problem because of a situational aspect of his job may be made a worthy member of a workgroup by eliminating the disturbing element. In some cases the change may be slight, yet yield major results. An employee who is upset because a new worker has been hired at a higher salary to do the same work—an unfortunate, but not infrequent situation in an extremely tight labor market—may return to normal by a just handling of his complaint.

Finding Right Man for Right Job

There are numerous remedies that center around the employee's job assignment. For example, if the difficulty is essentially the result of over- or underplacement, a transfer may be indicated. It may be practical to add or subtract job elements that can eliminate the difficulty. Where tailoring the job is not practical, helping the employee qualify for a post which he is better suited for may remedy the situation. In some cases retiring the employee ahead of schedule may help solve the problem of ill health or underqualification.

Occasionally a cure for a problem situation means dealing with other employees in the group. Instances of unfair or callous treatment, ganging up on an individual, may call for supervisory intervention. Just what is said or how of course depends on the individuals involved. In most cases one of two approaches gets results: an appeal to the fair-mindedness of the individuals; an assertion of supervisory authority.

In some firms, company rules, regulations or policies put an employee into a conflict situation. A case of this kind came up recently in connection with a handicapped employee. Because of physical disability, the employee — a member of a five-man team — was forced to take more and longer rest periods than permitted. Since the team was perfectly willing for him to have this special privilege and, as a matter of fact, since they adjusted their own work pace to accommodate their handicapped colleague, an exception was made, to the satisfaction of all concerned.

Crying on the Wrong Shoulder

The company that is alert to the extensive damage caused by problem employees can build up personnel policy or supervisory practice. The Personnel Department must not be pressured into hiring underqualified people, or in permitting unrealistic personnel practices. Secondly, supervisors are apt to fall into a trap from which there is no escape. Witness this little drama:

Supervisor: "Tom, you've been late two times in the past week. Checking the records, I see that you have more late starts than any other employee in the department."

Tom: "That's true, Mr. Smith, but you know how undependable the bus service is. Every once in a while I switch to a car pool, but we still buck the traffic jam, and there are all kinds of delays."

One cannot help sympathizing with such a worker. But the supervisor must realize that the employee is trying to place his problems on the company's shoulders. True, transportation may be undependable. True, traffic jams can be time consuming. But isn't it the employee's responsibility to turn up on the job at a given hour, ready for work, just as all the other workers do?

Once a supervisor shows a willingness to make the employee's problem *his* problem, he has opened a Pandora's box. Just as the boss has certain responsibilities, so does the worker. Making the employee aware of his responsibilities and the need to live up to them, provides the best remedy for this kind of problem situation.

Dealing with Problems

Too often managers lose sight of a significant aspect of the problem employee situation. This is the seemingly simple fact that a "bad apple" represents a different kind of problem at different organizational levels. For example:

. . . AT THE SUPERVISORY LEVEL —the problem employee represents an immediate and direct challenge. Because, the presence of an underproductive, wasteful or rebellious worker may constitute a threat to the supervisor's leadership or authority, he is most directly involved.

. . . STAFF—To the personnel department, the troublesome worker may be a less immediate but a more serious problem. At stake may be company-wide personnel policy, for example. And, where problem employees tend to show up in more than minimal numbers, the performance of the personnel department itself may come under fire because of aspersions cast on its recruiting, hiring, training and employee relations policies.

. . . TOP MANAGEMENT — To executives at the top, the problem employee is generally thought of as a difficulty that others down the line are being paid to handle. Therefore, top management tends to be studiously disinterested, except where the problem employee in question is a member of management itself. This generalization naturally has exceptions. The mishandling of a single employee problem can cause repercusions of such serious dimensions that top management may have to step into the picture.

. . . EMPLOYEE LEVEL—Fellow workers also have an involvement and point of view about a problem employee. It can go either way. Sympathy and identification in one case may lead workers to side very strongly with the individual in question. But, when other employees are affected detrimentally by the behavior or attitude of the man, they may render judgments even harsher than management's.

Who Are Your Problem Employees?

A list of typical "bad apples" was prepared by a group of managers at a special seminar held by Cornell University. Most common problem types included:

- Absentee
- Accident prone
- Overly dependent
- Hostile
- Professional gossip
- Overambitious
- Social misfit
- Overplaced
- Underplaced
- Self-glorifying
- Argumentative
- Insubordinate

EDITORIAL

Growing Competition

► Our attention has been directed to a situation which needs a good deal of coherent thought. There has been much publicity about growing synthetic rubber capacity in Western Europe, but far less has been said about the rapid growth of capacity outside Western Europe and North America. It may come as a source of surprise to some that by the end of the current year the capacity to produce synthetic rubber outside Europe and America will be in the order of 45,000 long tons. By 1961 it is expected that this figure will grow to 180,000 long tons; by 1962 to 250,000 long tons, and by the end of 1963 to 300,000 long tons.

It has been pointed out by several trade sources that by the end of 1962, the world outside Europe and America should be self-sufficient in synthetic rubber. In addition, foreign producers will be competing in their own markets with United States manufacturers who, at the present time, meet almost all the requirements of these countries. It should also be noted that Western European producers will also be active in these new markets.

Whatever the conclusions one chooses to draw from these figures, one factor is particularly evident — the historical markets are changing and it may be that synthetic rubber producers may have to concentrate more heavily upon domestic markets in the years to come. As it happens, synthetic rubber exports this year have been high — higher than expected by many in the trade earlier in the year. Our concern is now with the years ahead. What *will* be the situation in 1962 and in 1963?

Philosophically (and business paper editors sometimes indulge in this luxury) we often have the feeling that the well put question helps to arrive at satisfactory answers. To this end we would raise these questions:

- Is the natural rubber stockpile disposal program functioning in the best interests of all concerned?

- Are investments in foreign synthetic rubber producing facilities sufficient to compensate for a projected loss of markets?

- Where and how are capital investments in the United States being made? Toward production increases? Toward automation?

- What roll is the government playing in facilitating foreign trade?

Let us think about these matters — let us think of the years that lie ahead. We are encouraged, incidentally, by the formation of the International Institute of Synthetic Rubber Producers. This organization, we are sure, will serve to define and clarify many of these questions. Certainly we are all agreed that answers must be found.

Goodrich-Gulf Offers Polyisoprene Licenses

► Goodrich-Gulf Chemicals, Inc., Cleveland, Ohio, has inaugurated an active program for granting licenses to manufacture synthetic-natural rubber (polyisoprene) to producers in the United States and Canada. Goodrich-Gulf will offer licenses to manufacture synthetic-natural rubber under its own patents together with sublicenses under the pertinent catalyst patents of Dr. Karl Ziegler, plus company production techniques worked out in the firm's pilot plant facilities over a period of more than five years.

Lucien O. Crockett, president of Goodrich-Gulf, said that licenses to manufacture this recently developed polymer will be granted on a nonexclusive basis. In making this announcement, Mr. Crockett stated that his company is prepared to start negotiations immediately with manufacturers interested in producing synthetic-natural rubber.

Court Decision

The announcement by Goodrich-Gulf follows the recent issuance of a consent decree by the U. S. District Court for the District of Columbia terminating a legal action filed by the government against the B. F. Goodrich company on May 8, 1957. The settlement agreement is the result of lengthy negotiations between the Federal government, the B. F. Goodrich Company and Goodrich-Gulf Chemicals, Inc. Goodrich-Gulf voluntarily became a party to the law suit for the purpose of completing a settlement of the conflicting claims. Goodrich-Gulf Chemicals, Inc. is jointly and equally owned by the B. F. Goodrich Company and Gulf Oil Corporation.

The agreement reached by the parties will make available to licensees research and development carried out by Goodrich-Gulf subsequent to the termination on April 29, 1955, of the government research contracts with the synthetic rubber industry, as well as the patent rights acquired from Dr. Ziegler.

In accordance with the terms of the settlement, Goodrich-Gulf will be entitled to receive royalties of 2½ per cent of the net sales price of synthetic-natural rubber manufactured in the United States and Canada. Potential licensees will be offered terms which, in addition to royalties, will include an initial cash payment and a further cash payment following establishment of a firm plant production capacity.

Mr. Crockett comments that these royalties are modest and are designed to encourage broad participation in the manufacture of the synthetic-natural rubber so essential to the welfare of the nation. Mr. Crockett points out that the United States no longer need be dependent on tree rubber. He states that despite the rapid growth in the usage of other synthetic rubbers in recent years, this country still uses over 500,000 long tons of natural rubber annually.

URW to Mark Anniversary

► Preliminary plans for a nationwide celebration have been approved by the Executive Board of the United Rubber Workers Union, which will celebrate its 25th anniversary in September. L. S. Buckmaster, URW president, said the union will produce a picture history in pamphlet form which will be widely distributed. Other highlights of the celebration will be a pageant staged in conjunction with the international convention, to be held in St. Louis, Mo., September 19 through 23, and an essay contest conducted among union members and their children. Mr. Buckmaster said local unions will be encouraged to hold 25th anniversary dinners.

Castro Regime Seizes Three Rubber Plants

► The Cuban plants of three rubber companies owned by U.S. interests which control a total of about $24 million worth of Cuban facilities were seized on September 2 in a move that seemed to be the first of a new series of economic maneuvers against this country. Plants belonging to U.S. Rubber, Goodyear, and Firestone were taken over, and a fourth company, Goodrich, narrowly escaped confiscation of its plant because 80 per cent of the Cuban branch is held by a Mexican subsidiary. U.S. Rubber investments in Cuba are said to total $9 million; Goodyear, $8 million; and Firestone, $7 million.

The four companies have, in the past, filled almost all Cuban requirements for tires and other rubber goods, either through their own facilities, or through imports, leading to current speculations that Cuban industry may be in a vulnerable position, particularly if the rubber companies retaliate by halting heavy purchases of rayon and nylon cord from Cuba. U.S. Rubber points out that the current demand for all of the products manufactured by the company in Cuba is high, particularly for the footwear items.

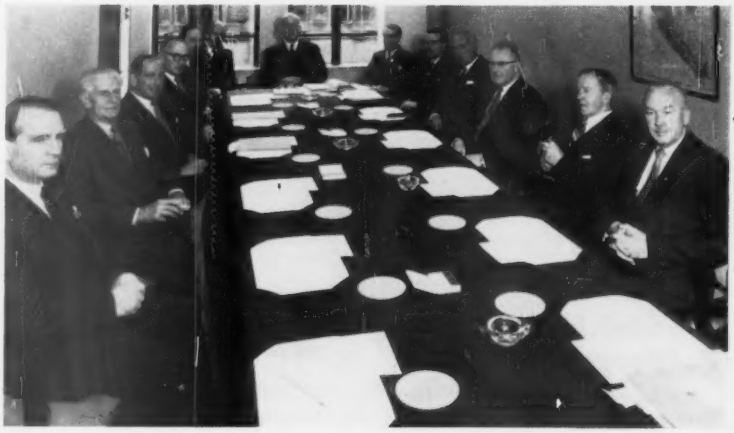
American Embassy

According to the American Embassy in Cuba, Cuban soldiers moved in on the three plants following accusations by workers that the companies were trying to cut production to sabotage Dr. Castro's revolution, in what has already become a familiar pattern. Policy in at least one of the major companies, U.S. Rubber, has been to employ Cuban nationals to the maximum extent possible in responsible executive posts. Only nine of the 750 people employed in the company's Cuban operations are American nationals.

There are indications that other U.S. properties on the island may be seized.

NRB Advisory Group Holds First Meeting

► A basic element in the recent reorganization and expansion of the Malayan natural rubber producers' world-wide research effort was the establishment of a high-level advisory body known as the Coordinating Advisory Committee. The function of the committee is to advise the Malayan Rubber Fund Board, governing body of the Malayan growers' expanding research and development efforts, on the programs to be carried out by the board's three research arms, the Natural Rubber Producers' Research Association, the Rubber Research Institute of Malaya, and Rubber Technical Developments, Ltd.



The Coordinating Advisory Committee of the Malayan natural rubber producers, set up by the Malayan Rubber Fund Board to advise on scientific research, holds its initial meeting at the London, England, headquarters of the Natural Rubber Bureau. From left to right: P. O. Wickens, secretary of the committee; H. B. Egmont Hake and E. D. Shearn, respectively, chairman and vice-chairman of the Research & Development Committee of the Rubber Growers' Association; E. A. Murphy, director of research, Central Research Division, Dunlop Rubber Co., Ltd.; Sir Harry Melville, secretary of the Department of Scientific & Industrial Research; Dr. L. Bateman, director of the Natural Rubber Producers' Research Association; Sir Geoffrey Clay, chairman of the committee, controller of Rubber Research and chairman of the Malayan Rubber Fund Board; C. E. T. Mann, formerly director of the Rubber Research Institute (Malaya); D. J. Flunder, general purchasing manager, Dunlop Materials Supply Division, Dunlop Rubber Co., Ltd.; R. B. Carey, formerly Member for Works, Federation of Malaya; Dr. J. G. Mackay, chairman, Francis Shaw & Co., Ltd.; Sir Eric Rideal, former professor of colloid chemistry, Cambridge University; and E. Jago, London representative of the Malayan Rubber Fund Board.

$4 Million Annually

At the Coordinating Advisory Committee's inaugural meeting, held recently in London, England, Chairman Sir Geoffrey Clay, the Malayan Rubber industry's Controller of Rubber Research, noted, "It is the aim of the Malayan government and the Rubber Producers' Council to make the natural rubber industry one of the most progressive basic industries in the world." He said that his industry was now spending some $4 million annually on research and development.

In addition to Sir Geoffrey, the committee comprises 15 members drawn from rubber production, business, government and scientific ranks. The membership emphasis however, is on the latter, with seven scientists being members of the group. Dr. W. E. Cake, vice-president in charge of coordinating research and development, U. S. Rubber Co., New York, N. Y., is one of the scientific members.

Natural and Synthetic

Speaking of natural *vis a vis* synthetic, Sir Geoffrey referred to the "healthy competition" between these two basic commodities. He pointed out that this would benefit the consumer, and added that industry needed both rubbers. He remarked that what was shaping up between natural and synthetic rubber was not a dispute for supremacy, but rather a progressive partnership which both could healthily share.

He underscored that "the potentialities for future development may well prove as great in the field of natural rubber as that of synthetic." With an eye to the fact that trees currently being planted in Malaya will produce three and four times today's average yield, the chairman of the committee noted that "the yield and cultivation of the rubber tree already has been improved out of all knowledge, and the application of science to the tree is revealing further exciting possibilities. One of the promising lines of research is concerned with the application of hormones to stimulate yields."

Sir Geoffrey stated that on the basis of the last several years' experience natural rubber, said to be the best general purpose elastomer, would be hard put to fulfill its share of rising world demand. He underscored that it was therefore essential that natural rubber be utilized with greatest efficiency, that manufacturers be able to get full benefits from new developments, and that manufacturers be helped to choose precisely the right rubber for any given job from the range of natural rubbers now available.

To facilitate these aims, Sir Geoffrey reported that technical service to manufacturers by personal representation was being expanded rapidly. In the United States, a new Technical Service Division was instituted in February 1960. With its headquarters at the Natural Rubber Bureau offices in Washington, D. C., it is expected that by 1961 there will be natural rubber technical service representatives in leading rubber centers in the United States.

Appointed by Goodyear

► D. H. Francis has been appointed manager of chemical products production for the Goodyear Tire and Rubber Co., Akron, Ohio, effective January 1, 1961, replacing H. I. Belknap, who will become a consultant in chemical production operations. Mr. Francis has been general manager of the firm's subsidiary Portsmouth, Ohio, atomic plant since 1956. This post will be filled by G. H. Reynolds, formerly manager of the atomic plant's Production Division.

In addition to his new duties, Mr. Francis, starting in September, will direct the selection of the management team for the firm's new synthetic rubber plant in Beaumont, Texas. He was named manager of the synthetic plant at Houston in 1949, and in 1952 was one of 28 men selected to organize the Portsmouth atomic plant.

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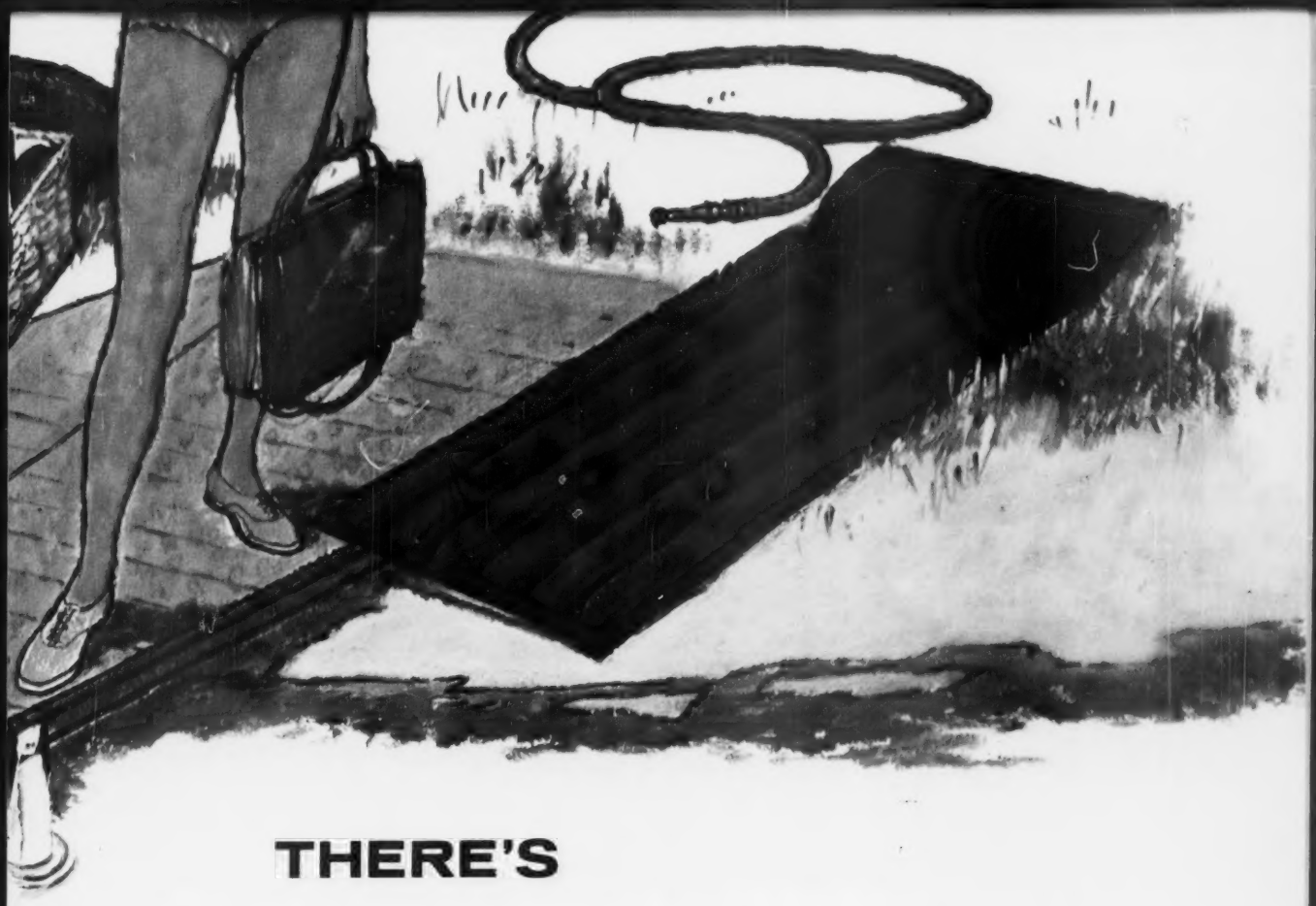

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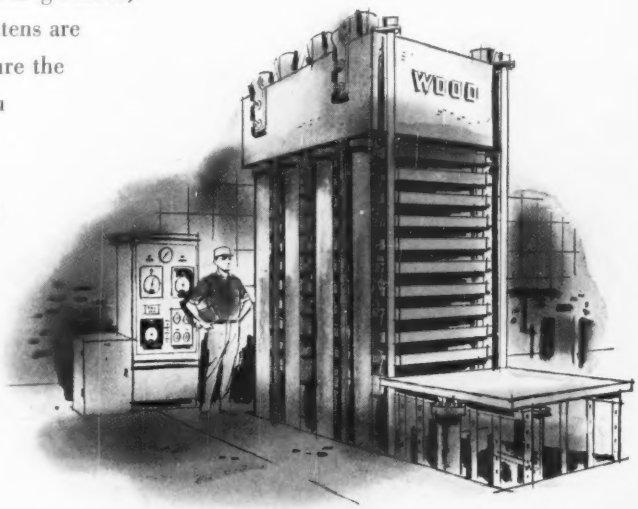

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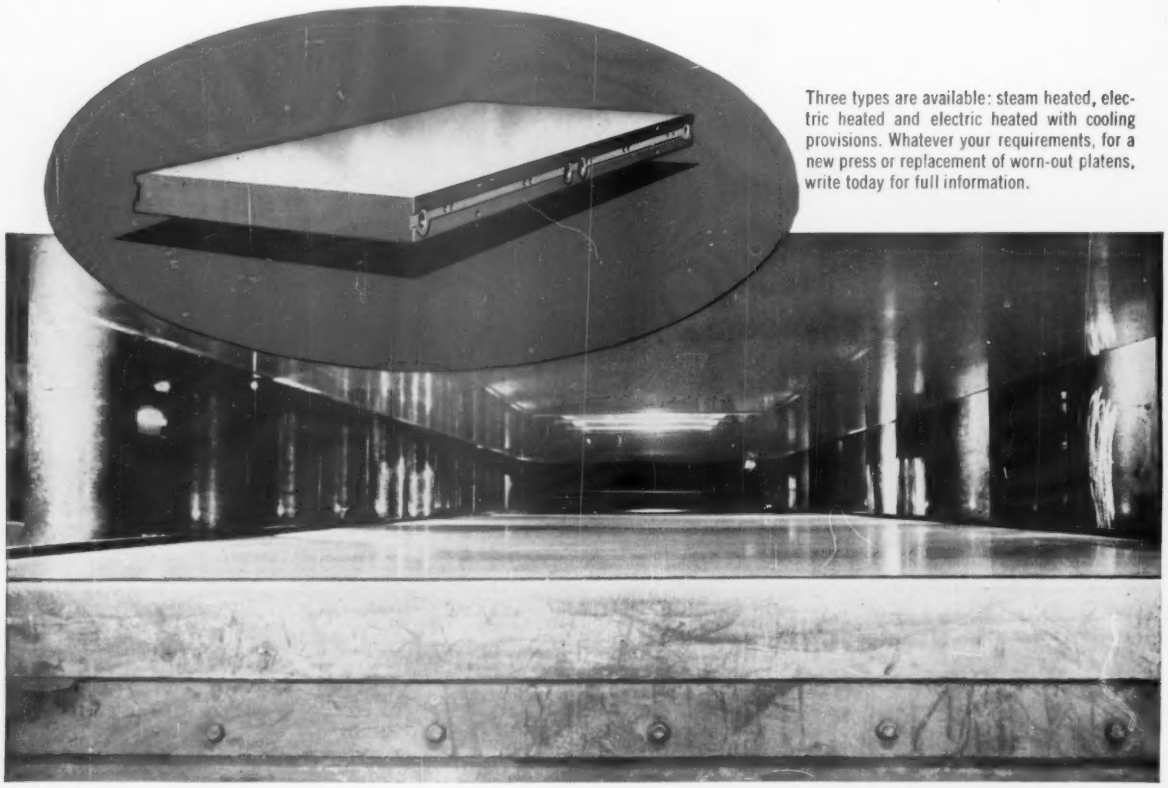

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Carbon Black Industry Expanding World Wide

► Major carbon black producers are setting up overseas manufacturing operations because the rubber industry, which takes over 95 per cent of the carbon black output, is expanding abroad at a rate said to be double that of the United States. Companies exporting manufacturing and sales techniques include United Carbon Co., Houston, Texas; Columbian Carbon Co., New York, N. Y.; Phillips Chemical Co., Akron, Ohio; and Godfrey L. Cabot, Boston, Mass.

Capacity to Double

According to reports, by 1963 or 1964 new overseas plants, most of which will be financed in whole or in part by the American industry, can be expected to more than double foreign production capacity to about 1.2 billion pounds. In spite of the growth of overseas carbon black plants, American producers have shipped 237,218,000 pounds in the first five months of this year, compared with 204,498,000 pounds in the same period of 1959. Last year, American producers shipped abroad a record 513 million pounds or 26 per cent of a total output of nearly 2 billion pounds. Exports for 1960, according to estimates, are expected to show an increase of about 15 to 17 million pounds to reach an annual figure of about 530 million pounds.

New Black Plants

Until this year, the European Common Market had only two major carbon black manufacturing facilities — Degussa's in Frankfort, West Germany, and the Cabot plant at Berre, France. It is expected that within two years new carbon black plants will encircle the Common Market countries — France, Germany, Italy, Belgium, Holland and Luxemburg.

Two new carbon black plants recently went on stream near Rotterdam, Netherlands. One of these plants, licensed by Godfrey L. Cabot, Ketjens Carbon Ltd., is expected to produce about 60 million pounds of carbon black annually. The other Netherlands plant is a joint operation between Columbian Carbon and Continental Carbon. This unit has an estimated annual capacity of 30 million pounds.

In Italy another 110 million pounds of carbon black will be added to European production when the proposed plants of Cabot, Phillips and Columbian-Continental go on stream. The Columbian-Continental plant is being built in Treacate, adjacent to Italy's Milan-Turin tire manufacturing center. Phillips Chemical owns 50 per cent of a 25 million pound capacity plant which is being built in Ravenna. Cabot Italiana, a subsidary of Godfrey L. Cabot, is also building a plant in Ravenna. This facility will have an estimated 30 million pound carbon black capacity.

In Port Jerome, France, United Carbon expects to have its 50 million pound capacity plant on stream early in 1961, Phillips and Continental are jointly building a 55 million pound capacity unit in Bordeaux, which is expected to begin production by the end of 1960.

In England, United Kingdom Chemical, Ltd., which is producing close to 260 million pounds of carbon black annually under a royalty agreement with United Carbon and Philblacks, Ltd., licensed by Phillips, estimates that by 1964 its annual production should near 300 million pounds.

Phillips Carbon Black Pty, Ltd., expects its 22 million pound capacity factory in South Africa to go on stream late in 1960. Phillips shares a half interest in this unit with Industrial Development Corp. of South Africa.

Phillips, together with Duncan Bros. of Calcutta and private investors, is building a 22 million pound capacity plant in Durgapoor, India. Production is expected in late 1961.

In Japan, carbon black production is rated at 40 million pounds per year, but is expected to reach 110 million pounds by 1964 due to the licensing agreement recently signed by Columbian Carbon with Mitsubishi Chemical, and by Phillips with Showa Denko.

J. G. Eisenhart

J. L. Masters

J. L. Oglesbee

D. Eisenhart

Firestone Names Four Representatives

► Four new sales representatives have been appointed by the Firestone Synthetic Rubber & Latex Co., Akron, Ohio. The appointments are: John G. Eisenhart, Philadelphia, Penna., area; Jerry L. Masters, Akron area; Jack L. Oglesbee, Atlanta, Ga., area; and David Eisenhart, Boston, Mass., area.

Starting with Firestone in the Akron Synthetic Division in 1949, John G. Eisenhart transferred to the company's Production Planning Department in 1955. He rejoined the synthetic rubber plant in the Sales Department early in 1960. Jerry L. Masters joined Firestone Synthetic Rubber Division in 1955. Since 1957 he has been assigned to the Technical Service Department.

Jack L. Oglesbee joined the Sales Department of Firestone Rubber & Latex Products in Fall River, Mass., in 1959. He transferred to the synthetic rubber company's operations in May of this year. David Eisenhart, who has been a sales representative in the Ohio area, started with Firestone in 1955 as a laboratory technician in the synthetic plant. In 1957 he was transferred into the Sales Department and has been Ohio area sales representative during the past year.

In New Harchem Post

► Wallace E. Riffelmacher, of the Harchem Division of Wallace & Tiernan Inc., Belleville, N. J., has been transferred from the Sales Department to the Product Development Department. Mr. Riffelmacher will assist in the introduction of new plasticizers, dimer acids and epoxy additives.

Armed Forces Slate Conference

On Elastomer Development

► The 6th Joint Army-Navy-Air Force Conference on Elastomer Research and Development will be held October 18-20 at the Statler-Hilton Hotel, Boston, Mass., with Dr. J. C. Montermoso, QMR&D Command, serving as general chairman. A dinner for the registrants will be served at the hotel on the evening of October 19, with General Trudeau of the Army Research Office as the speaker.

Opening remarks at Session I will be made by Dr. G. R. Thomas, Chief, Chemical and Plastics Division, QMR&D Command; introduction, by Brig. General Merrill L. Tribe, Commanding General, QMR&D Command, and welcome address by Major General Andrew T. McNamara, the Quartermaster General. Chairmen at the various sessions will be: Session II—Basic Polymer Research, J. M. Kelble, Wright Air Development Division; Session III—Special Applications, Dr. J. H. Faull, Jr., Office of Naval Research; Session IV—New Elastomers, Dr. R. F. Dunbrook, NRC Advisory Board on QMR&D. Concluding remarks will be by the general chairman. Abstracts of 36 technical papers to be presented at the various sessions follow:

CHAIN ENTANGLEMENTS AND MECHANICAL PROPERTIES OF AMORPHOUS POLYMERIC SYSTEMS, by T. G. Fox (Mellon Institute). Observations of viscous and viscoelastic behavior of amorphous linear polymeric systems have been interpreted in terms of the postulated formation of networks of long, entangled molecular chains. Recent evidence indicating the need for a more sophisticated theory of the nature and effect of these "entanglements" and their dependence on structural factors will be discussed.

CHAIN DIMENSIONS OF POLYMERIC CHAINS, by C. A. J. Hoeve (Mellon Institute). Chain dimensions of polymer molecules in bulk or concentrated solutions can now be obtained by general methods for any kind of interaction between groups along the chain, using extensions of the matrix methods, first given in 1932 by Eyring. An increasing amount of evidence is now available, suggesting that the conformations in the liquid and crystalline state possess the same absolute value of the rotational angles, especially for polymers with bulky substituents. Calculations for polyisobutylene and polyethylene are in satisfactory agreement with experiment.

ROLE OF ENTANGLEMENTS IN DEGRADATION OF ELASTIC NETWORKS, by K. W. Scott, V. R. Allen, and M. Morton (University of Akron). Sol-gel relations in natural rubber vulcanizates have been studied both during network formation and degradation. The experimental values obtained during network formation, using the usual swelling measurements to determine cross-link density, deviated markedly from theory, both as to magnitude and by showing an unexpected dependence on the primary chain length. The total number of elastically effective chain entanglements per unit volume was found to be a function of the concentration of "chemical" cross-links. Based on this modified theory, it was concluded that the thermal degradation of a number of vulcanizates of natural rubber occurs by the random scission of network chains.

RELATIONSHIP OF POLYMER STRUCTURE TO CHEMICAL RESISTANCE, by K. C. Tsou and B. D. Halpern (Borden Chemical Co.). Attempts have been made to correlate some aspects of polymer structure to polymer resistance to toxic chemical agents. Crystallinity, isotacticity, melting point, molecular weight, and the chemical structure of the polymers is considered. While no single factor can be said to be a deciding influence on the resistance of the polymers to the chemical agents, crystallinity and isotacticity are definitely important contributions to better chemical resistance and this specific area will be discussed. The effect of functional groups, prepared by a variety of methods in substituted polystyrene, on the resistance of chemical agents will also be discussed.

ANTIOXIDANT ACTION IN POLYMERS, by F. H. Winslow, W. L. Hawkins, and Mrs. A. C. Worthington (Bell Telephone Laboratories, Inc.). Carbon black, an immobile pigment, acts as a mild thermal antioxidant in polymers. The degree of protection depends on oxygen or sulfur content of the carbon rather than on volatile impurities or unpaired electron concentration. However, highly effective antioxidants obtained by interaction of carbon black with organo-sulfur compounds depend on the polynuclear aromatic nature of carbon instead of its oxygen content. The action of these protectants is considered in terms of current oxidation theory.

ZONE REFINING FRACTIONATION OF POLYMERS, by J. D. Loconti (QMR&D Command), and J. W. Cahill (Lord Manufacturing Co.). The ability of the zone refining process to yield materials of fantastic degrees of purity shows it to be extremely selective in distinguishing between different molecular species. When applied to polymers, the process is able to distinguish between close molecular weight species, and is able to effect a fractionation of the polymer. Data have been obtained showing the dependence of the distribution coefficient on molecular weight. Experimental difficulties such as maintaining narrow and uniform zones and achieving adequate mixing are believed to be responsible for failure to realize the full potential of the method.

MECHANISM OF AMINE CROSS-LINKING OF FLUOROELASTOMERS, by K. L. Paciorek (Wyandotte Chemical Corp.). The copolymers of vinylidene fluoride-chlorotrifluoroethylene and vinylidene fluoride-perfluoropropene are readily cross-linked by amines. To establish the mechanism of this process, studies of the polymer systems and of model compounds were undertaken. Solution studies of the two fluoroelastomers indicated that dehydrohalogenation was the initial step in the cross-linking process, usually taking place at temperatures lower than those required for the cross-linking reaction itself.

AROMATIC FLUOROCARBONS: THERMAL STABILITY AND SYNTHESIS, by L. A. Wall (National Bureau of Standards). In order to select the best structure and linkages for high thermal stability, a series of small molecules were studied in a qualitative fashion. The thermal decomposition and photo oxidation of poly, 2,3,4,5,6,pentafluoro-styrene was also studied. Reactions of aromatic fluorocarbons, which are conceivably adaptable to polymerizing or coupling phenylene groups in a chain, are being explored.

POLYMERS WITH AROMATIC RECURRING UNITS, by C. S. Marvel (University of Illinois). Work directed toward the synthesis of polymers containing only aromatic units will be covered. The types which will be discussed include (1) polyphenyls, (2) polyquinolines, (3) polymers with alternate phenyl and thiazole rings, (4) polymers with alternate phenyl and oxadiazole rings, and (5) fully aromatic polybenzimidazoles. The syntheses, reactions and heat stabilities of the various types will be considered.

SYNTHESIS OF ORGANOLEAD POLYMERS RELATED IN MOLECULAR STRUCTURE TO THE SILICONE ELASTOMERS, A. D. Delman, B. B. Simms, E. Klein, and J. Mironov (New York Naval Shipyard). This paper covers the results of initial studies made to synthesize and characterize organolead polymers, based on the molecular structure of the poly-siloxanes, for use by the Navy in applications requiring superior resistance to degradation by environmental agents such as ultra-high temperatures, ionizing radiation energy, and corrosive rocket propellant chemicals. Five approaches, leading to the possible preparation of siloxane polymers containing lead in either the backbone or in side-chain substituent groups, are presented. Data are given on the molecular structure and high temperature resistant properties of several organolead materials synthesized by the laboratory in this semi-inorganic polymer program.

SILICON-NITROGEN POLYMERS AND THEIR COORDINATION, by E. G. Rochow (Harvard University). The potentialities of Si-N polymers have not heretofore been sufficiently explored. The

incorporation of nitrogen into such a structure introduces the possibility of coordination polymerization, which would result in a more tightly-bound structure and in improved thermal and hydrolytic stability. In the present work, two kinds of Si-N polymers are recognized: silylamines, in which an Si-N-C structure is obtained; and silazane, in which silicon and nitrogen atoms alternate in an Si-N-Si-N structure.

THERMALLY STABLE METALLIC SALTS OF POLYVINYLPHTHALIC ACID, by E. C. Winslow and A. Laferriere (University of Rhode Island). The synthesis of 4-vinylphthalic acid was achieved starting with commercially-available trimellitic anhydride. The monomer was polymerized in aqueous solution with a peroxydisulfate (hyposulfite redox catalyst system). Addition of various soluble salts to a neutralized solution of the polymer caused the precipitation of metallic salts of polyvinylphthalic acid. The thermal stability of several of these polysalts has been investigated by the techniques of thermogravimetry and differential thermal analysis. Atmospheric control was utilized with differential thermal analysis so that oxidative effects were minimized. The evaluation of thermal stability showed that the alkaline earth polysalts were stable up to 550° C.

POLY(TRIORGANOMETALLOXY)- AND POLY(CHELATED)-METALLOXANE POLYMERS, by C. L. Segal, H. H. Takimoto, and J. B. Rust, (Hughes Aircraft Co.). The alkoxy-acyloxy reaction was utilized to prepare a number of poly-(triorganometalloxy) metalloxane polymers in which the metals used were titanium, aluminum, silicon or tin. The polymers ranged from viscous fluids to rigid solids. Polymers containing tin in the linear polymer chain or in the side group were also prepared by the alkoxy-acyloxy reaction.

EFFECTS on ELASTOMERS OF EXPOSURE AT TEMPERATURES UP TO 1000°F., by L. J. Kitchen (Firestone Tire and Rubber Co.). Vulcanized pads of 18 types of elastomers were exposed to high temperatures. After contacting an 800°F. metal surface for three minutes, all of the samples except silicone rubber and Viton showed extensive surface decomposition. However, due to the insulating effect of the elastomers, very little heat damage took place within the pads. Only the Hevea vulcanizate had lost more than half of its tensile strength at a distance of 0.075 inch from the surface. Vulcanizates also were exposed, in nitrogen, at a distance of 0.25 inch from a 1000°F. metal surface. Damage was superficial.

HIGH TEMPERATURE FUEL TANK SEALANTS, by P. A. House (Wright-Air Development Division). The Air Force is investigating fuel tank sealants for use in advance design air weapons. Resistance to high temperatures is a prime consideration. Sealants have been obtained which exhibit adequate properties after subjection to temperatures up to 600°F. for considerable periods of time. A room temperature curing system for fluoroelastomers has been discovered, and attempts are being made to utilize this system for sealant materials.

A HIGH TEMPERATURE ANTIOXIDANT SYSTEM FOR CROSS-LINKED POLYETHYLENE, by C. I. Carr and R. Miller (U.S. Rubber Co.). Polyethylene, above its melting point, is a rubber, but it lacks strength and recovery. This can be overcome by reinforcment with a filler, like carbon black, and by cross-linking with a suitable peroxide, or by radiation. Marlex Type 2 linear polyethylene, which had been reinforced with 50 parts of carbon black and cured by these methods, exhibited tensile strengths of 400 psi to 800 psi and elongations of 150 to 200 per cent when tested at 450°F. The values varied with the types of carbon black that were employed.

NEW MONOMERS FOR POTENTIAL RADIATION RESISTANT POLYMERS, by W. L. Beears and R. J. Fawcett (B. F. Goodrich Co.). Aromatic polymers usually possess better radiation resistance than non-aromatic polymers. A series of fourteen acrylic monomers containing phenyl or naphthyl groups was chosen so that the resulting polymers have the aromatic groups at different positions on, and distances from, the main polymer chain. The structure of these monomers will be discussed in groups, with correlation of the mode of attachment, the type of aromatic group, and its distance from the polymer "backbone."

COMPRESSION SET PRODUCED BY IRRADIATION OF RUBBER VULCANIZATES CONTAINING DIFFERENT AMINE ADDITIVES, by W. E. Shelberg and L. H. Gevantman (Naval Radiological Defense Laboratory). Compression set in natural rubber vulcanizates caused by gamma irradiation was investigated. A high degree of set (crosslinking, etc.) excludes an elastomer from use as a gasket or seal. Therefore, 57 widely diversified amines selected as potential anti-rads were incorporated individually into a standard, natural rubber. Compression set was measured after a stress recovery period at an elevated temperature. At least five additive compounds were observed to give protection by lowering the degree of compression set caused by the radiation.

ON THE MECHANISM OF IONIZING RADIATION DAMAGE OF SBR ELASTOMERS, by A. D. Delman, I. J. Stanley, B. B. Simms, A. E. Ruff and E. Goldberg (New York Naval Shipyard). This paper covers an investigation of the degradative effects of high-energy irradiation of SBR elastomers; correlating the influence of molecular weight distribution, molecular chain length, concentration of bound and uncombined styrene, and solvents on the mechanism of radiation attack of the polymers.

ELASTOMERS FOR CRYOGENIC SEALING, by F. W. Tipton, G. E. Trepus and R. S. Roper (Boeing Airplane Co.) and D. H. Weitzel and R. F. Robbins, (Cryogenic Engineering Laboratory, National Bureau of Standards). Elastomers possess properties which make them ideal seal materials at normal temperatures. As the operating temperature of the system becomes extremely low, certain property limitations become evident. This paper deals with the work done to overcome these physical property deficiencies of elastomeric materials so that satisfactory elastomeric seals can be obtained at cryogenic temperatures. The problem was approached through consideration of the material, seal configuration, and gland design. Such physical properties as compression-deflection thermal expansion, and effective coefficient of expansion at various compressions, were determined at cryogenic temperatures.

COMPATIBILITY OF ELASTOMERIC COMPOSITIONS IN NITROGEN TETROXIDE AND CHLORINE TRIFLUORIDE, by J. Green and N. Levine (Reaction Motors Division of Thiokol Chemical Corp.). Fluorocarbon polymers and fluorosilicones were evaluated for compatibility with nitrogen tetroxide and chlorine trifluoride. The investigation of techniques for coating elastomers with fluorocarbon polymers, and the vacuum deposition of metals onto rubber cores is reported. The resulting compositions were evaluated for compatibility in nitrogen tetroxide and chlorine trifluoride.

RHEOLOGICAL AND SPRAY PROPERTIES OF DILUTE POLYMER SOLUTIONS, by L. Cohen and G. W. Rodon (Army Chemical Center). A method for studying the rheological and spray properties of dilute polymer solutions with a jet extrusion instrument and a capillary flow consistometer is demonstrated. The rheological properties that can be determined at any shear rate of extrusion are the normal (tensile) stress, the elastic shear modulus, the elastic recoverable shear strain and viscosity. The spray properties of dilute polymer solutions can be qualitatively described in such terms as a knotted rod, knotted ligaments, long ligaments, threaded drops, grouped drops, or combinations thereof.

RUBBER MATERIALS FOR DAMPING VIBRATION OF METAL STRUCTURES, by R. E. Morris (Mare Island Naval Shipyard). The reduction of self-noise of naval vessels is highly desirable. A high level of self-noise reduces the effectiveness of active and passive sonar on surface vessels, and facilitates detection of submarines by the enemy. One way of reducing self-noise in ships is to dampen the vibration of the hull and contiguous structural members. This laboratory has found that the vibration of metal shapes can be dampened by adhering rubber sheets thereto. The rubber used for this purpose must have a high viscosity in the frequency range where damping is desired.

COMPOSITE SEAL MATERIALS, by M. Sabanas and F. Iwatsuki (Armour Research Institute). A summary will be presented of the work and results of a research program aimed at the development of new concepts using novel and unconventional material combinations which would have resilience, recovery, strength, and chemical resistance at temperatures up to 1200° F. Major emphasis has been given to configurations which would be suitable for static and dynamic reciprocating shaft seals. Basic materials used were stainless steel and molybdenum fibers felted and bonded into a skeleton of desired shape and size. The fiber skeletons were filled with a second material to give two completely interpenetrating continuous phases.

TRANSIENT PROPERTIES OF THREE CASTABLE POLYURETHANE COMPOUNDS, by W. B. Lew and W. Sergeant (Puget Sound Naval Shipyard). Three catalyzed polyurethane compounds

having initial viscosities ranging from 4,000 to 13,000 centipoise were cast to form cylindrical specimens in order to determine transient properties during cure at 47°F., room temperature, and 212°F. over a period of four weeks. Volumetric swell hardness, and compression set were employed to follow changes in the physical properties. Two sets of specimens using the three compounds were cured for three days under desiccated conditions prior to immersion at room temperature; one set in ASTM oil No. 1 for twenty-five days, and the other set in water for twenty-six days. These specimens exhibited less than 5 per cent volumetric change.

INVESTIGATION OF FOAMED RESILIENT MATERIALS AND RUBBERIZED HAIR FOR PACKAGE CUSHIONING APPLICATIONS, by S. A. Eller, A. A. Stein and C. K. Chatten (New York Naval Shipyard). An analysis was made of the service conditions of package cushioning materials. Based on this analysis, the pertinent physical properties which characterize the suitability of package cushioning materials were selected and laboratory procedures to evaluate these properties, including shock and vibration attenuation under simulated service conditions, were developed. Load-compression, energy absorption, hysteresis, creep and compression set data obtained on representative samples of both polyester and polyether types of urethane foam, rubberized hair, foamed polystyrene, neoprene and butadiene-styrene foam are presented herein. Based on this preliminary data an analysis is made of the suitability of these materials for package cushioning applications.

COMPOUNDING RUBBER FOR PROTECTIVE MASKS, by H. H. Anderson (General Tire and Rubber Co.). A study of the compounding of natural rubber for protective mask face-pieces and related items was made. Improvements in tear resistance, low temperature properties and ozone resistance were particularly sought. The use of a wide variety of carbon blacks was studied. Careful selection and blending of these blacks gave compounds with physical properties much superior to those containing only mineral pigments such as have been widely used for protective masks. The superior tear resistance of stocks containing SAF black is particularly noteworthy.

VULCANIZABLE SATURATED ELASTOMERS IN MEDICAL APPLICATION, by F. Leonard (Army Prosthetics Research Laboratory). Latex dispersed synthetic elastomers and foam compositions based on a terpolymer of butyl acrylate, methyl methacrylate and methacrylamide have been prepared and their properties studied. The elastomer has been found to be nontoxic and body tissue compatible. Composite structures consisting of terpolymer foam and woven dacron have been fabricated for use as vascular prostheses, chest wall reparative materials and heart valves. Films have been used for artificial trachea as well as for facial prostheses and other external body applications.

LOW TEMPERATURE POLYESTER ELASTOMERS, by A. W. Sloan (Atlantic Research Corp.). Terpolymers containing ester, amide, and urethane groups as the components of the polymer molecule were synthesized to obtain rubbers characterized by elastomeric and fuel-resistant properties at very low temperatures. A polyester prepared by condensing methyl diethanolamine, isosebacic acid (a mixture of C_{10} acids) and triethanolamine, when chain extended and cross-linked with hexamethylene diisocyanate, yielded an elastomer which was flexible over the temperature range of —100°F. to +150°F. This elastomer was resistant to attack by aliphatic hydrocarbons.

EVALUATION OF CYANOPROPYLSILICONE ELASTOMERS, by D. B. Braun and E. W. Bennett (Union Carbide Corp.). The development of practical cyanopropylsilicone elastomers has progressed to a reportable stage where detailed properties — including fluid resistance, physical and electrical properties, low temperature behavior, and response to formulation variables — will be discussed.. Because new chemistry and compounding techniques are involved, the optimum combination of properties remains to be found. However, specific property areas where high performance levels have been achieved will be shown.

SYNTHESIS OF ARYLENE-MODIFIED SILOXANES, by G. M. Omietanski and W. G. Reid (Union Carbide Corp.). An important characteristic of silicone elastomers is their ability to maintain useful mechanical properties over a wide temperature range. One approach in seeking improvements in physical strength is through alternation of polymer backbone flexibility by incorporation of thermally and oxidatively stable structures which are relatively rigid and bulky. A reasonably accessible class of chemical structures meeting these requirements is the bis-silylarylenes. Laboratory preparation of the bis-silylarylene monomers and their copolymerization to form linear high polymers will be described. The stress-strain-temperature properties of elastomers based on various copolymers will be presented.

HEAT AND RADIATION RESISTANT ARYLENE MODIFIED POLYSILOXANES, by Z. Ossefort (Rock Island Arsenal). Among currently available elastomers, those having the greatest heat resistance, viz. the silicones and fluoroelastomers, are most susceptible to the damaging effects of high energy radiation. The objective of this work was to provide elastomers having improved heat and/or radiation resistance. The properties of a series of arylene modified polysiloxanes prepared by the Silicones Division, Union Carbide Corp., under contract to this Arsenal will be covered in this presentation. The processing, compounding and vulcanization will be briefly covered and analysis data presented.

THE SYNTHESIS OF FLUORINE-CONTAINING MONOMERS, by P. Tarrant (University of Florida). A new method has been developed for the preparation of 2-perfluroalkyl-1,3-butadienes in two steps from vinylmagnesium chloride and the appropriate ketone. In common with other tertiary alcohols containing the perfluoroalkyl and hydroxy group on the same carbon atom, dehydration was not successful; however, pyrolysis of the acetate led to the desired diene.

Several methods have been developed for the preparation of ethers containing fluorine. 2-(2,2,2-Trifluoroethoxy)-1,3-butadiene has been made. Unsaturated ethers containing fluorine have been successfully prepared from vinyl and allyl ethers via free radical reactions. The ethers containing either the $-O-CF_2CHFCl$ or $-OCH_2CF_3$ behave considerably differently from those containing the ethoxy group.

SYNTHESIS OF FLUORINATED NITROSO MONOMERS, by A. P. Stefani, J. R. Lacher and J. D. Park (University of Colorado). It was reported that the reaction of nitrosyl chloride (NOCl) and certain fluoroolefins lead to products which resulted by an effective addition of nitrosyl chloride (NO_2Cl) and of chlorine across the double bond. We have been successful in carrying out the synthesis of nitroso derivatives from nitrosyl chloride or nitric oxide (NO) and fluorinated olefins in a continuous flow system over anhydrous ferric chloride.

NITROSO-FLUOROCARBON ELASTOMERS, by G. H. Crawford, D. E. Rice and J. C. Montermoso (Minnesota Mining & Mfg. Co.). The copolymerization of CF_2NO with fluoroolefins to yield elastomeric gums and thermoplastics was first reported by the writers at the October, 1958 JANA Conference on Elastomers. Since then the QMC sponsored research effort at 3M has concerned itself with numerous macromolecules having -N-O containing heteratomic backbones. The nitroso family of elastomers represents the first true "fluorocarbon" elastomers and have been found useful as model compounds for the study of the effect of type and location of substituent moieties of polymer properties. Polymerization across the nitroso bond occurs via a free-radical mechanism. A study of the kinetics of the (I)/(II) copolymerization has clarified the various steps in this unique polymerization reaction.

PROPERTIES OF VULCANIZED NITROSO ELASTOMER, by J. C. Montermoso, C. B. Griffis and Angus Wilson (QMR&E Command). A copolymer of trifluoronitrosomethane-tetrafluoroethylene is an elastomer having a molecular weight of over a million as determined by light scattering technique. It is a completely saturated (no double bonds) elastomer and contains no hydrogen. It has an entirely new structure with a -N-O-C-C- in the backbone of the molecular chain. Methods of vulcanization and compounding techniques, including data on physical and chemical properties, will be presented. Results obtained thus far showed the rubber to possess a good combination of low temperature flexibility, chemical resistance and non-flammability.

To Buy Southern Latex

► Negotiations for the sale of Southern Latex Corp., Austell, Ga., and its subsidiaries, to International Latex Corp., Dover, Del., have been completed, subject to approval of the board of directors of both companies. Southern Latex will operate as an autonomous company with no change in management or policies. The purchase price was not disclosed.

ASTM D-24 Adopts Specs For Rubber

► Tentative specifications for carbon blacks used in rubber products have been adopted by ASTM Committee D-24 on Carbon Black, at its annual meeting on June 28 in Atlantic City, N.J. Subcommittee 7 on Specifications for Carbon Blacks recommended the following editorial changes, which were approved by Committee D-24: change Table 1 to specify a 5-minute Fines test; change Section 8 (a) to read, "Any material which fails in one or more of these test requirements shall be retested. For this purpose, two new random samples shall be tested for the requirement in which failure occurred. Failure of either of the retests shall be cause for final rejection.";

Add sentence to Section 3 (b) to read, "Reference black and test black compounds shall be prepared and tested at approximately the same time.";

Change Section 1 to read, "These specifications cover carbon black for ultimate use in rubber products and include both tests for the properties of blacks when incorporated in rubber, and certain properties of the blacks themselves as received by the consumer."

At the D-24 meeting, the report of the Nomination Committee was read, and the following officers were elected unanimously for two-year terms: *Chairman*, N. P. Bekema (U. S. Rubber); *Vice-Chairman*, J. F. Svetlik (Phillips Chemical); *Secretary*, T. D. Bolt (Godfrey L. Cabot); *Advisory Committee*, Dr. I. Drogin (United Carbon); R. F. Jones (Firestone); C. A. Carlton (J. M. Huber); K. A. Burgess (Columbian Carbon); L. G. Mason (Goodrich); R. B. Knill (Goodyear).

Polyethylene Compound

► Union Carbide Plastics Co., New York, N. Y., has introduced an improved high density polyethylene compound for wire and cable applications. The new resin, Bakelite DGD-4100, is said to combine the advantages of greater toughness, high abrasion resistance, reduced compressibility and better heat deflection with greatly improved resistance to stress cracking and thermal embrittlement. Already approved under several industry specifications, the new formulation is described in Extrusion Technical Release No. 19, available from Union Carbide Plastics Co., 30 East 42nd St., New York, N. Y.

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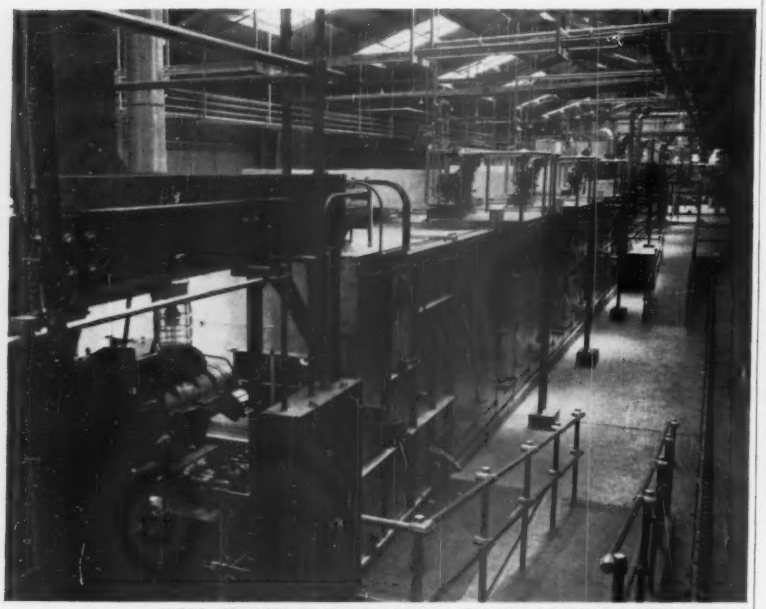

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N.Y. Rubber Group Holds Golf Outing

► Over 260 members and guests attended the New York Rubber Group Golf Tournament on August 2 at the Forsgate Country Club in Jamesburg, N. J. The Golf Committee handling the day's arrangements included: D. H. McCondichie (Merck), chairman; W. R. Hartman (Laurie Rubber Reclaiming), vice-chairman; K. E. Chester (C. P. Hall); Thomas Farley (R. T. Vanderbilt); G. Rudeau (Whittaker, Clark & Daniels); and P. V. Fullam (DuPont).

Wes Curtis (Naugatuck Chemical) won first prize for members with a low gross of 73. R. Stimets (United Carbon) and A. H. Woodward (DuPont) were tied for second low gross with an 80. Third low gross went to W. Weber (Glidden). First, second and third low gross prizes for non-members went to A. Leffler, with a 76; L. Laibe, with a 77; and C. Basilone, with a 78.

S. Linderman (Glidden) won first prize for the longest drive of 260 yards. Second prize went to Wes Curtis (Naugatuck Chemical) with a 248 yard drive, and R. Dudley (Whitney Blake) came in third with a drive of 228 yards.

First prize for coming closest to the pin was won by R. Emmett (Columbian Carbon), with B. Topcik (Eberhard Faber) taking second prize. R. Rossman (Godfrey L. Cabot) and A. Leffler (guest) finished in a first place tie in the putting contest. A hole-in-one was scored by J. L. Been (Rubber & Asbestos) on the seventh hole, and the highest score was carded by N. S. Beekley (Goodyear).

Tells of New Tylac Types

► Tylac 3040, and Tylac 3500 series, modified butadiene-styrene latices, have been announced by the Chemical Division of International Latex Corp., at Dover, Del. Tylac 3040, which is self-curing, is designed for textile, carpet, upholstery and rug applications. The Tylac 3500 series is designed to meet paper coating industry needs. It is said to offer improved adhesion, wet rub resistance, smoothness and gloss, and to have excellent mechanical stability. According to the company, savings of 5 to 15 per cent can be realized by using a lower level of Tylac 3500 in place of the normal level of a conventional latex, if higher pick resistance is not required.

NCRG Holds Outing; Fusco Addresses Group

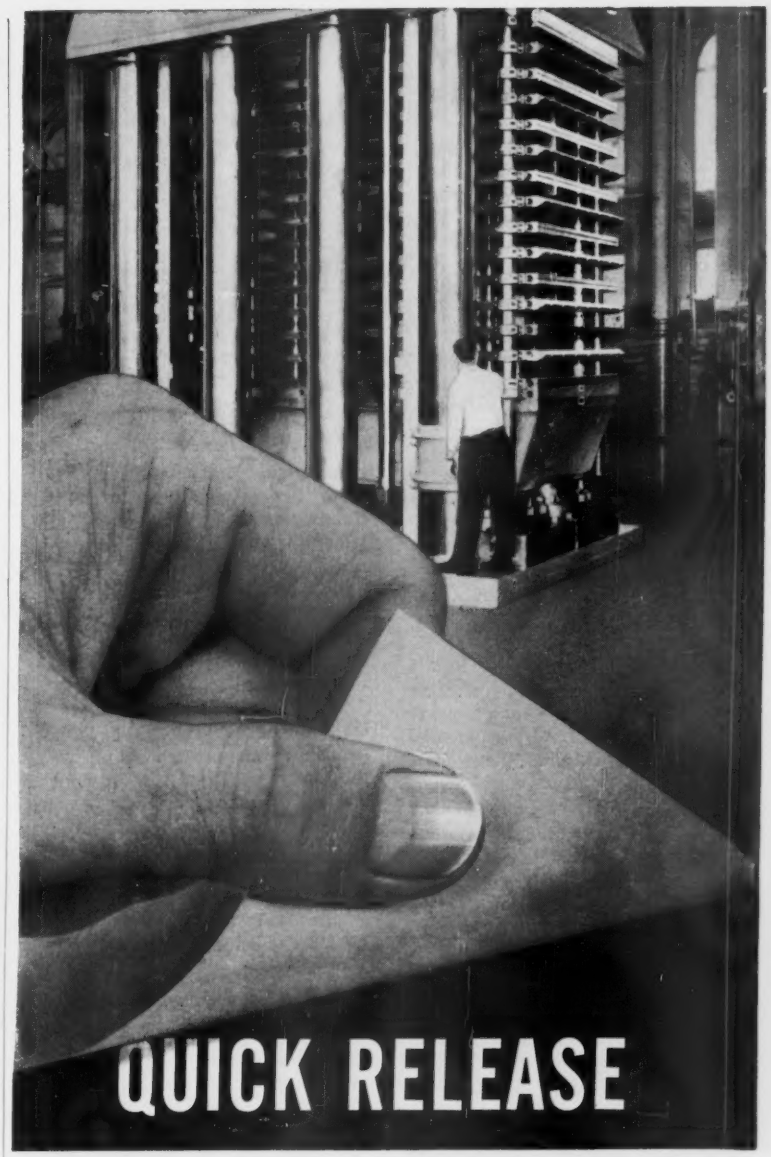
► The Northern California Rubber Group held its Annual Golf Outing on June 17 at the Green Hills Country Club in Millbrae, Calif. Twenty-five golfers participated in the golf tournament and 35 members and guests attended the dinner and presentation of awards following the conclusion of the tournament. Rodger Thatcher (Union Rubber) served as chairman of the Golf Committee, assisted by Eugene Gador (B. E. Dougherty) and Bob Moore (Harwick Standard).

The prize winners in the golf tournament were: *Low Gross, first,* Albert Federico (C. P. Hall), *second,* H. Melvin (Titanium Pigment), *third,* Donald Carr (Enjay); *Low Net, first,* Karl Johnson (H. K. Porter), *second,* Bob Moore (Harwick Standard), *third,* Richard Claussen (H. K. Porter); *Closest to Pin on Seventh Hole,* Joe Mattson (Witco); *Longest Drive on 18th Hole,* Victor Carriere (Mansfield Tire & Rubber). Karl Johnson (H. K. Porter) was the winner of the Witco Trophy.

On May 12, the Northern California Rubber Group held a technical meeting at the Elk's Club in Berkeley, Calif. Featured speaker at the meeting was James V. Fusco (Enjay), who discussed "The Chemistry and Properties of Chlorinated Butyl."

Mr. Fusco remarked that chlorinated butyl is essentially a chlorine-containing butyl polymer prepared by carefully controlled chlorination of butyl rubber. He pointed out that during chlorination, the double bond in the isoprenyl group of the butyl molecule shifts from the 2,3 position to the 1,2 position with a chlorine addition to the allylic carbon of the double bond. According to the speaker, the inherent activity of the allylic chloride in the modified polymer molecule makes possible a large number of cross-linking systems not available to the parent butyl molecule.

He explained that dual functionality, double bond, and allylic chloride enhance re-activity to provide faster cure rates, and in some instances of vulcanization, carbon-to-carbon links are postulated to give improved heat aging properties. The increased activity also promoted a new degree of compatibility of a butyl-type polymer with other unsaturated elastomers such as butadiene-styrene rubber and natural rubber, Mr. Fusco stated.



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Big Four and URW Reach Wage Pact

► A 9½c hourly wage increase plus extra allowances for skilled trade employees has been agreed upon by the rubber industry's Big Four—Firestone, Goodyear, Goodrich, and U. S. Rubber—and the United Rubber Workers Union. Over 75,000 rubber workers are affected by the wage agreement.

Firestone, with 17,200 workers, in 8 cities, and Goodyear, with 21,000 workers in 11 cities, were the first to settle with the URW, coming to terms on July 30. Goodrich, with 12,600 workers in 6 cities, settled on August 1, and U. S. Rubber, with 26,000 employees in 16 cities, agreed to the wage increase on August 3. Terms of the U. S . Rubber agreement are retroactive to August 1, compared with retroactivity of July 25 for the three other firms.

In the Firestone agreement, in addition to the 9½c general increase, a 4c hourly adjustment increase was included for skilled workers in Akron, Ohio; Des Moines, Iowa; Los Angeles, Calif.; Pottstown, Penna.; and Memphis, Tenn., plants. Other Firestone plants are at Fall River, Mass., New Castle and Noblesville, Ind.

Goodyear Package

The Goodyear package provides for a 5½c hourly adjustment for skilled workers in Akron and 6½c for employees in Jackson, Mich., both in addition to the general increase. Goodyear also operates plants in Gadsden, Ala.; St. Mary's, Ohio; Topeka, Kansas; Lincoln, Nebr.; Los Angeles, Calif.; North Chicago, Ill.; New Bedford, Mass.; Windsor, Vt.; and Muncie, Ind.

The Goodrich agreement, in addition to the general increase, provides for additional increases of up to 5c an hour for skilled workers. The pact covers employees in Goodrich plants at Akron, Ohio; Los Angeles, Calif.; Marion, Ohio; Oakes, Penna.; Riverside, N. J.; and Tuscaloosa, Ala.

Adjustments of up to 7c hourly for skilled workers, in addition to the general increase, were included in the U. S. Rubber terms. The U. S. Rubber plants covered in the wage agreements are at Chicopee Falls, Mass.; Eau Claire, Wisc.; Philadelphia, Penna.; Los Angeles, Calif.; Naugatuck, Conn.; Mishawaka, Ind.; Providence, R. I.; Detroit, Mich.; Indianapolis, Ind.; Chicago, Ill.; North Bergen and Passaic, N. J.; Woonsocket, R. I.; Washington, Ind.; Painesville, Ohio; and Santa Ana, Calif.

Prior to the wage agreements, the average hourly wage for the companies were: Goodyear, $2.72; Firestone, $2.85; U.S. Rubber, $2.53; and Goodrich, $2.74.

The rubber companies and the United Rubber Workers have now reached annual settlements on wages for six years in a row without a strike. The last pay strike was against Goodyear in 1954, for 51 days. However, in 1959 the URW shut down Firestone, Goodrich, and U. S. Rubber plants for from three weeks to two months in disputes over non-economic issues.

U. S. Minimum Tire Wage

In August, the minimum wage for Government tire, tube and retread work was set at $1.77 an hour. The rate was announced by Secretary of Labor James P. Mitchell, acting under provisions of the Walsh-Healy Act which permits the Government to set minimum wage rates in certain industries. The Government ruling means that no firm paying wages lower than $1.77 an hour would be permitted to bid on federal contracts. Government purchases of tires and tubes come to about $60 million a year.

Secretary Mitchell set the rate on the basis of evidence submitted during hearings in Washington, D. C., in 1959. At the hearings, the United Rubber Workers recommended a rate of $1.93 and counsel for the rubber industry suggested that the minimum rate should be $1.54. Both groups based their arguments on statistics from the Department of Labor. Secretary Mitchell's determination represents a compromise figure.

Win ACS Paper Award

► W. A. Smith, group leader, and J. M. Willis, research chemist, at Firestone Tire and Rubber Co., Akron, Ohio, will be awarded the Best Paper Award of the Division of Rubber Chemistry of the American Chemical Society. Their paper, "Diene Rubber—Compounding and Testing," which appeared in the August, 1960, issue of RUBBER AGE, was initially delivered at the Spring Meeting of the division.

Atlas Sublicensing Tomarkin Process

► In the August, 1958, issue of RUBBER AGE, there appeared a feature article by Leandro W. Tomarkin describing a new method for increasing tire traction on wet, snowy and icy surfaces. Atlas Supply Co. of Newark, N.J., has now entered into a general license agreement with Dr. Tomarkin under which Atlas is licensing tire manufacturers to produce Tomarkin-treated tires in the Atlas brand. This sublicensing agreement entitles the tire company to manufacture the treated tire in any other brand that he may produce, or to utilize the process in tread rubber. Atlas is also sublicensing manufacturers of tread rubber including many small shops as well as tire companies.

Under the sublicense agreement with the manufacturers of tires and tread rubber, it is agreed that the material will be used in first line or better quality stock and that the material will be used in at least the top two-thirds of the anti-skid. The agreement also stipulates the relative amount of material to be used in order to achieve the optimum traction improvements that are possible.

Tomarkin Process

The Tomarkin Process involves the chemical and mechanical treatment of tire treads to improve traction under most winter driving conditions. A selected elastomeric material, in particle form, is introduced into the tread rubber mix during the final stage. This material, when milled into the rubber, is said to impart added friction to the tread.

In addition, the process increases traction and anti-skidding action of the tire through a mechanical treatment. This treatment induces controlled and progressive formation of depressions (about 1/25-inch) on the tread surface. These are said to have a unique cooperative effect with localized modified tread areas.

Chicago Meeting Dates

► The Chicago Rubber Group has announced its technical meeting dates for the remainder of 1960 and early 1961. All meetings will be held at the Furniture Club in Chicago. The meeting dates are: *1960*, October 7 and November 18; *1961*, January 27, March 10 and April 28.

Rubber Hall of Fame Adds Seventh Member

► A seventh member will be added to the International Rubber Science Hall of Fame of the University of Akron at the annual symposium and banquet, to be held November 18 in the Student Center Hilltop Dining Room. The new member will be selected by a committee headed by Dr. Maurice Morton, professor of Polymer Chemistry and director of the Institute of Rubber Research. The program will consist of an afternoon symposium and presentation of professional papers, and an evening banquet and award ceremony.

Five men who had made memorable contributions to the science of rubber chemistry were initiated into the Hall of Fame when it was established in 1958 in conjunction with the University's 50th anniversary celebration of the teaching of rubber chemistry: Charles Goodyear, C. Greville Williams, Carl O. Weber, Henri Bouasse, and Ivan I. Ostromislensky. Thomas Hancock was added to the gallery of notables at the 1959 Hall of Fame banquet. Pictures of the men are displayed in the Rubber Science Hall of Fame located in the Science and Technology Division Library of the university.

Those interested in attending the symposium and banquet may make reservations through the Director of University Relations, The University of Akron, Akron 4, Ohio.

New Synthetic Process

► Crawford & Russel, Inc., Stamford, Conn., an engineering firm, has announced a new synthetic rubber process which it has developed through the pilot plant stage. The method is based on an elastomer-solvent system, and bypasses crumb-type coagulation of conventional emulsion processes. It is said to offer an investment saving of about $500,000 on a plant rated at 30,000 pounds per year, and to reduce operating costs by ¼ to ½c per pound.

The process starts with an elastomer-solvent mix containing 20 per cent solids. The solvent is stripped by extruding the solution over a bed of water at 200° F., the strings of elastomer combining to form a continuous sheet. In a second pass, the sheet is completely desolventized under hot water and dried in a low-cost dryer. The dried product is said to be tacky enough to be easily baled for shipment to molders.

Erich Konrad

Named Colwyn Medallist

► Erich Konrad, former director of the rubber laboratories of I. G. Farben, Leverkusen, Germany, has been awarded the Colwyn Medal, the highest honor of the Institution of the Rubber Industry, London, England. His work on the polymerization and development of synthetic rubbers influenced the research later connected with Buna and Perbunan. The setting up of synthetic rubber plants as early as 1936 can be largely attributed to his work on rubber synthesis, and his work in this line was recognized by the Gold Medal awarded to him by the Committee of the International Exhibition in Paris, 1937.

Dr. Konrad was educated at the Universities of Kiel and Tuebingen, and graduated from Freiburg University in 1922. He taught and lectured at the chemical laboratories at Freiburg University until he entered the Farben laboratories in 1927. In 1936 he was promoted to manager and, at the same time, he was elected chairman of the German Rubber Society in recognition of his work on synthetic rubber. The Central Laboratories for rubber were designed and built under his management in 1937-38, at which time he was in charge of all matters pertaining to research, development and production of rubber. In 1939 he was named director.

Named by Hard Rubber

► Gerald A. Boughton, with the company for 27 years, has been named manager of the Akron plant of American Hard Rubber Co., Butler, N.J. He succeeds E.J. Boebinger, resigned, who held the post for the past three years.

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26 Papers Scheduled For ASME Conference

► Twenty-six papers are scheduled to be presented at the technical program at the annual meeting of the Rubber and Plastics Division of the American Society of Mechanical Engineers, to be held on October 10 and 11 at the Hotel Lawrence in Erie, Penna. Concurrent rubber and plastic sessions are scheduled for Monday and Tuesday mornings, October 10 and 11, while a plastics session will be held Monday afternoon and a rubber session on Tuesday afternoon.

The complete technical program follows: *Monday morning, Session 1A—Plastics:* "Novel Design in Sandwich Structures" by A. C. Marshall (Hexcel Products); "New Apparatus for Study of Mechanical and Electrical Properties of Plastics" by S. M. Skinner and E. L. Kern (Case Institute); "Reinforced Plastic Films as an Engineering Material" by Dr. Johan Bjorksten (Bjorksten Research Laboratories); and "Plastic Pipe for Industry and the Home" by L. L. Loudin, Jr. (Marbon Chemical);

Session 1B—Rubber: "Processing Equipment for Liquid Urethane Elastomers" by J. A. Hanzel (DuPont); "Presses in the Rubber and Plastics Industry" by Everett Perlberg (Adamson United); "Automated Tire Curing Room" by L. E. Soderquist (McNeil Machine); "A New Visco-Elastic Compound for the Suppression of Noise and Vibration in Structures" by C. H. Peterson (Lord Mfg.); and "Magnetic Rubber—A New and Useful Material" by R. J. Webster (Denman Rubber);

Monday afternoon, Session 2—Plastics: "Air Structures—A New Concept in Engineering Design" by Walter Bird (Birdair Structures); "Thermoforming—Its Processes and Applications" by J. R. Lynch (Dow Chemical); "Adhesion Theory" by J. E. Rutzler, Jr. (Case Institute); and "Stress-Strain Relations in Cross-Linked Polyethylene" by I. L. Hopkins (Bell Labs);

Tuesday morning, Session 3A—Rubber: "The Analog Computer and its Application in the Rubber and Plastics Industry" by Adolph Katz and Paul Berthiaume (Princeton Computation Center); "An Introduction to Biaxial Stress Problems in Fabric Structures" by A. D. Topping (Goodyear Aircraft); "Fabric Space Structures" by J. T. Harris (Goodyear Aircraft); "Elastomers as a Structural Material" by E. E. Thielker (DuPont); and "Engineering Planning and Design Requirements for the Handling of Collapsible Rubber Containers" by Neuberne Brown (OTD Container);

Session 3B — Plastics: "Design Strength Data and Calculation for Long-Term Use of Thermoplastics" by W. D. Harris (Dow Chemical); "Obtaining Stress Per Cent Compression Diagram of Foamed Plastics at High Rates of Compression" by R. C. Dove, W. E. Baker (University of New Mexico) and C. D. Beaman (Creole Petrol); and "Annual Review of Engineering Developments in the Plastics Industry" by George Jackson (Monsanto);

Tuesday afternoon, Session 4—Rubber: "Dracone-Flexible Barges—Some Problems of Design Materials and Construction" by Warburton Hall (Ministry of Aviation, London); "Elastomers Applied to Structural Damping" by Bruce Campbell (Lord Mfg.); "Automotive Engine Mount Design" by A. L. Everitt (Inland Mfg.); "Elastomeric Gyro Suspensions by J. W. Gwinn (Lord Mfg.); and "Polyester and Hypalon Foams to Plywood" by C. A. Wilkinson (C. A. Litzler).

Two tours are planned as part of the technical program. On Monday afternoon a tour of the Hammermill Paper plant is scheduled, and a tour to a molded fiber glass plant is scheduled for Tuesday afternoon. A luncheon will be held on Monday, October 10, with Dr. Turner Alfrey (Dow Chemical) as guest speaker.

Schubert Heads Emery

► A. W. Schubert has been elected president of Emery Industries, Inc., Cincinnati, Ohio. In addition, the company announced formation of a European company owned jointly with Unilever, N.V., of Holland, to be called Unilever-Emery, N.V. It will have its headquarters at Gouda, Holland, where construction of a plant is under way. Mr. Schubert succeeds John J. Emery, who fills the newly-created post of chairman of the board. Mr. Schubert, who was formerly executive vice-president, joined Emery Industries in 1924 as a cost accountant, after receiving a degree from the University of Cincinnati College of Engineering.

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FS-11

1200 Persons Attend Akron Summer Outing

► A full day's activities were enjoyed by over 1200 members and guests at the Annual Summer Outing of the Akron Rubber Group, held on June 17 at the Firestone Country Club in Akron, Ohio. The golf tournament had 411 participants, the Decathlon event had 190 entries, and 50 persons competed for prizes in the Giant Putter contest.

Frances W. Burger (Phillips Chemical) was general chairman of the outing. Dan Chovan (Witco) was chairman of the Golf Committee, which included J. E. Graves (Continental Carbon), S. P. Clary (Goodyear), W. S. Hall (Phillips Chemical), D. G. Gingold (Sid Richardson Carbon), H. E. Pence (St. Joseph Lead), J. R. Smith (Goodrich-Gulf), E. J. Becker (General Tire), L. A. Anderson (Leverett A. Anderson Co.), J. E. Miles (Akron Chemical), A. E. Laurence (Phillips Chemical), Ronald Ohm (American Zinc), and John Bennett (Goodyear).

Members of the Prize Committee included, C. R. Simpson (Harwick Standard), chairman; James Willis (Firestone); H. D. Ruth (J. M. Huber); P. Bullock (Godfrey L. Cabot); and Charles Esakov. L. V. Cooper (Firestone) was in charge of the Committee on Location and Food. Maynard Bobbitt (Firestone) was chairman of the Decathlon Contest. The Ticket Committee was chaired by B. N. Larsen (Naugatuck Chemical), and V. F. Springer (Goodrich) was chairman of the Membership Committee. Publicity for the outing was handled by R. B. Knill (Goodyear) and J. P. Urbon (Goodyear).

Latex Foam Film On TV

► The complete story of latex foam rubber's varied contributions to America's constantly improving standards of living comfort is portrayed in a new public service motion picture recently completed by the Latex Foam Rubber Council, in cooperation with the National Association of Manufacturers. Produced as part of the Council's continuing consumer and industrial information program, the film explores both the manufacture and the many end uses of latex foam rubber. Entitled "Living On Air," the 13½-minute film is being put into national television distribution as part of the NAM's "Industry on Parade" series of TV feature newsreels.

In addition to an expected audience of approximately 18 million persons through the 262 United States television stations participating in the Industry On Parade program, the picture will be shown overseas through the cooperation of the United States Information Agency and the United States Armed Forces Press, Radio and Television Service. "Living On Air" is also being scheduled for non-TV showings throughout the country at women's clubs, schools, service clubs, home economics groups, etc.

Marsh Forms Company

► John L. Marsh, former vice-president of the Ansonia Wire & Cable Co., Ashton, R. I., has resigned to form his own sales company. Mr. Marsh will represent Ansonia in Florida, Alabama, and Georgia. The new company, John L. Marsh & Associates, will have temporary offices in Jacksonville, Fla.

L. V. Cooper (Firestone), at right, chairman of the Location and Food Committee for the Akron Rubber Group's summer outing, points out entertainment features of the Firestone Country Club to Milton Leonard (Columbian Carbon), group chairman.

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SRG Hears Panel On 'Coming Decade'

► More than 200 members attended the Spring Meeting of the Southern Rubber Group, held on June 10 and 11 at the Dinkler-Tutwiler Hotel in Birmingham, Ala. A regular business meeting and a seminar was held during the first day of the meeting. The seminar speakers were Walter M. Young (Richardson Scale), who discussed "Application of Weight Controllers to the Automatic Handling of Bulk Materials," and Paul F. Bertsch (DuPont), whose topic was "The Statistical Control Approach to Compounding." A banquet was held during the evening of the first day, and the guest speaker was Dr. William W. Carter (Redstone Arsenal).

The second day of the meeting was devoted to a panel discussion on the topic of "The Coming Decade in the Rubber Industry." Clayton F. Ruebensaal (Texas-U. S. Chemical), served as moderator of the panel which included Paul W. Cornell (Goodrich - Gulf), who spoke on "Developments in Polymer Types—Forecasts for the Coming Decade"; Dr. William F. Tuley (Naugatuck Chemical), whose topic was "Future Developments in Rubber Chemicals and Vulcanization Methods"; and H. K. Hochschwender (Hochschwender & Associates), who discussed "Projected Advances in Rubber Processing."

Recently-elected 1960-1961 officers of the Southern Rubber Group. Left to right: Martin Samuels (Copolymer Rubber & Chemical), treasurer; C. P. McKenna (Vector Mfg.), director; Lenoir Black (C. P. Hall), chairman; R. B. Camp (Goodyear), director; R. W. Rice (Firestone), secretary; Roswell C. Whitmore (Better Monkey Grip), vice-chairman.

Industrial Weighing

The first speaker at the seminar, Mr. Young, remarked that there is a common denominator in the handling of bulk materials by weight which is applicable to many industries. He pointed out that industrial weighing involves much more today than a scale which, important though it may be as a component in a system, is only one of many components.

The director of sales for Richardson went on to discuss weight controllers, pointing out that bulk materials vary infinitely in chemicals and physical properties and that there has not yet been developed a pat formula that simply classifies the properties and establishes the parameters for proper weight control. He explained to the group that the parameters for weight control of a process, for example, rubber compounding to a Banbury, are established only after thorough analysis of the process, time cycles, accuracy requirements, physical limitations, etc. According to Mr. Young, broadly, the weight control of a process falls into three categories—materials handling, weight sensing, and process instrumentation for weight control.

The second speaker at the seminar, Mr. Bertsch, asked the group to suppose that compounding investigations were carried out through aerial photography. He pointed out that we might consider the range of our lens being the limits within which we are to carry out our experiments. If we focus on a particular hilly piece of terrain and from the picture we take, are able to estimate elevation in feet, and if this elevation in feet were equal to tensile strength in pounds per square inch, we would have, according to Mr. Bertsch, information on the first property of interest to us. Following the supposition further, the speaker stated that if we next used film sensitive to infrared light only, we might photograph the same ground and establish a temperature profile. He explained that if a degree in temperature is equivalent to a per cent in compression set, we have information on a second property of interest.

Then, he continued, if we could take X-ray photographs which allowed us to measure the soil depth above rock and this depth in feet was equivalent to per cent, in elongation at break, we would have a third property. With these photo maps, Mr. Bertsch pointed out, we could solve a problem such as — where must I go within the range of the picture to get the highest elevation (tensile) without going into an area beyond some maximum temperature (compression set), being careful all the while to keep a certain depth of soil (per cent elongation) under our feet. With this anology in mind, the DuPont speaker proceeded to do some examples of aerial compounding using first the mathematical camera and then graphical equipment.

Mr. Ruebensaal, moderator of the panel discussion, stated, in his introductory remarks, that the coming decade should be one in which we

Members of the Southern Rubber Group's panel discussion on "The Coming Decade in the Rubber Industry." Left to right: H. K. Hochschwender (Hochschwender & Associates); Paul W. Cornell (Goodrich-Gulf); Clayton F. Ruebensaal (Texas-U. S. Chemical), moderator; and Dr. William F. Tuley (Naugatuck Chemical).

The Case of The
MYSTIC MONKEY
DON'T LOOK SO GLUM, JOHN!
I CAN'T HELP IT! SOME CONTAMINATED SOLVENTS SLOWED DOWN PRODUCTION AGAIN AND IF IT HAPPENS ONCE MORE...I'VE HAD IT!
HEY! LET GO!
DARN IT! SAY! WHAT'S THIS ABOUT SKELLYSOLVE IN THIS MAGAZINE AD?
TO KEEP OUT ALL CONTAMINANTS, SKELLYSOLVE PUMPS, LOADING LINES, STORAGE TANKS AND TANK CARS ARE...
FINE! WE'LL LOOK FOR DELIVERY RIGHT AWAY!
USED ONLY FOR SKELLYSOLVE! AND TANK CAR SHIPMENTS ARE MADE ONLY FROM THE REFINERY
PURCHASING AGENT
MINUTES LATER
CONGRATULATIONS, JOHN! PRODUCTION IS CLIMBING SINCE YOU SWITCHED TO SKELLYSOLVE... AND SO IS YOUR SALARY!
THANKS, BOSS!
SOME MONTHS LATER
THAT'S A BIG TIP FOR A MONKEY, JOHN!
IT'S NOTHING COMPARED TO THE TIP HE GAVE ME ON SKELLYSOLVE!

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SKELLYSOLVE-C. For making quick-setting cements with a somewhat slower drying rate than those compounded with Skellysolve-B. Closed cup flash point about 13° F.

SKELLYSOLVE-H. For general use in manufacturing operations and cements, where faster evaporation rate than that of Skellysolve-C is desired. Closed cup flash point about -16° F.

SKELLYSOLVE-L. For general manufacturing operations where a medium evaporation rate is required. Closed cup flash point about 12° F.

SKELLYSOLVE-R. For general use in tire building and a variety of other manufacturing operations and cements. Reduces evaporation losses. Medium quick final dry. Lessens bloating and skinning tendency. Closed cup flash point about -25° F.

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shall see commercial planning and market strategy as a dominant factor in determining our individual successful participation in the various burgeoning growth industries.

As a backdrop to the presentations of the three panelists, the director of commercial planning for Texas - U. S., discussed the growth pattern of rubber hydrocarbons and some factors which could affect the present trend. He pointed out that synthetic rubbers have had a spectacular growth history and now appear to be on the threshold of an equally colorful and dynamic period of development and expanding use.

Entering Third Phase

Panelist Cornell stated that we are now entering upon the third phase in the history of rubber types consumed in the United States. He explained that the first phase was the almost exclusive use of natural rubber for general purpose use — a period which started some 75 years ago and ended about 1943 when GRS became available in commercial quantities.

The second phase, he remarked, saw the rapid growth of synthetics. Not only GRS but the other more specialized rubbers such as neoprene, butyl, and nitrile as well—until the combined synthetics had captured about two-thirds of the total market. According to the Goodrich - Gulf vice-president, we are now entering phase three — a period which will provide improved SBR, polyisoprene, polybutadiene and other new synthetics so that by 1965, man-made rubbers of all types may have 75 per cent or more of the total market in the United States.

The next panelist, Dr. Tuley, stated that the manufacture of modern rubber products from natural rubber and synthetic elastomers is accomplished by the use of a great variety of synthetic organic chemicals which perform a special function. These organic chemicals, the chemicals research and development manager for Naugatuck Chemical pointed out, are supplied in physical forms which are generally easy to incorporate in the rubbers during processing and fabrication of rubber products.

Dr. Tuley informed the group that new synthetic rubbers, new processing methods, and increasing performance requirements create needs for chemicals to perform more effectively. He pointed out that the rubber and rubber chemicals industry will be spending 20 to 50 million dollars in the decade of the sixties on research to discover and to study the applications of such chemicals in the manufacture of rubber products.

Mr. Hochschwender, the final panelist, stated that the objective of his remarks is to focus attention on the rubber plant of the future and to aid in planning for this critical period ahead. The speaker laid out and planned a tire manufacturing plant as it might appear in the 1970's. He pointed out that from the standpoint of electronic data processing, it is simply necessary to obtain a greater understanding of the capabilities of the computers which we now have or are capable of constructing.

According to the panelists, it is in the phase of management thinking with reference to the concepts of organization and management philosophy that we find a most serious lag. It is evident, Mr. Hochschwender pointed out, that until organization practice catches up with technical developments, the most efficient integration of our modern technical equipment and our modern computers in our plant of the future will not occur.

An Industry Service

The Southern Rubber Group, as a service to the rubber industry in the area covered by the group, has formed a group-sponsored Placement Committee to serve as a clearing point for bringing qualified rubber-experienced personnel in contact with prospective employers. In order for the Southern Rubber Group to operate on a basis of helping and not creating difficult situations, it has established definite rules to govern the activities of the Placement Committee. The five points of the governing statement of policy are:

(1) The Placement Committee has been created to assist members and prospective members who are qualified, in obtaining contacts through which they many find a position in the rubber industry in the SRG area;

(2) The facilities of the Placement Committee are available to assist the personnel departments of the rubber industry seeking trained employees in technical, supervisory, and sales capacities;

(3) Neither the SRG or the Placement Committee assume any responsibility for finding positions.

(4) To incorporate a Certificate of Availability in our standard form thus assuring ourselves only unemployed, or applicants who are about to be unemployed would qualify for the service of this committee;

(5) All applicants must furnish the Placement Committee information on, or attached to our form. No guarantee of any kind is given to either party as to qualifications or veracity of statements made. The Placement Committee's function is solely to attempt to put the prospective employer and employee in contact with each other, if applicant is deemed eligible for consideration by the Placement Committee.

After receiving completed forms, the Placement Committee will process them and keep them on file for a period of 90 days.

Forms are available from committee members in the Southeast and Southwest: they may be obtained from Grady Oaks, Southeastern Rubber Mfg. Co., Athens, Ga., or John Wheelan, International Shoe Co., Bryan, Texas.

D.C. Group Holds Outing

► The Washington Rubber Group held its Annual Summer Outing on June 16 at the Bethesda Country Club in Bethesda, Md. Over 135 members and their families and guests participated in the day's activities, which included golf, bridge, swimming, and relaxation. Ted Scanlan (Gates Rubber) served as outing chairman, Elliot Bukzin (Bureau of Ships) supervised the running of the golf tournament, and Mr. and Mrs. Bill Dunkle (Goodyear) were in charge of the bridge tournament. The Carlisle Tire & Rubber contingent garnered most of the golf trophies with the help of Dave Williams. Mrs. Ted Scanlan was the only woman golfer, thereby sweeping all the women's golf prizes. The bridge tournament trophies went to Mrs. Dan Pratt and L. H. Brown (Lewis H. Brown & Co.). Highlight of the outing was a roast beef dinner, at which time golf and bridge trophies and over 40 door prizes were awarded.

U.S. Rubber Fined

► The U.S. Rubber Co., New York, N.Y., was fined $15,000 in Federal District Court in Denver, Colo., after entering a *nolo contendere* plea to a charge of conspiring to fix prices on foam rubber mattresses.

Dr. Stanley Jankowski, one of Neville's senior chemists, is shown here holding a test chart showing the results of tensile testing three aged rubber samples. The chart is just as it came from the Instron Tester, except that scribe lines have been inked over and labeled for visability in the picture. They have not been changed. From left to right, samples contained Neville's R-16 Coumarone-Indene Resin, competitive resin A and competitive resin B. Detailed results are shown below.

Competitive tensile test shows Neville Resin superior

Neville's R-16 Coumarone-Indene Resin was matched against two other leading resins in a neutral colored SBR test recipe compounded for comparative analysis. The results were as follows:

	Average Tensile	Aged Average Tensile	% Tensile Retention
Neville's R-16	1830 psi	1400 psi	76.5
Competitor A	1680 psi	1150 psi	68.5
Competitor B	1655 psi	1275 psi	77.2

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Firestone Opening Four New Plants

► Firestone Tire & Rubber Co., Akron, Ohio, will open four new plants in the next few months, and plans are underway for building a new synthetic rubber producing plant in Port Jerome, France, and a three-plant synthetic rubber complex in Bareilly, India. The announcement was made by Harvey S. Firestone, Jr., chairman and chief executive officer, as the firm observed its 60th anniversary on August 3.

The new installations now nearing completion are a plant in Orange, Texas, to manufacture Coral and Diene rubbers; a nylon producing plant in Hopewell, Va.; and tire plants in Calgary, Alberta, Canada, and Bethune, France. The new plants will bring Firestone's total to 75. They are part of a giant $120 million expansion and modernization program undertaken by the company during its 60th year.

"We are proud of the fact that in 60 years our company has grown from a small one-plant operation with a 12-man work force in Akron, Ohio, to a diversified enterprise with installations in 21 countries employing 85,000 people," Mr. Firestone said. "Even now we are on the threshold of a 10-year period that promises unprecedented growth," he added.

Background of Company

The company was founded by Harvey S. Firestone in 1900, and at that time it listed assets of $20,000. Sales in 1901 amounted to $110,000, and the first profit-making year was in 1903 which produced $8,503 profit on sales of $230,000. In 1905 the company paid its first dividend and the following year it passed the million dollar sales mark. The latest report for fiscal 1959 shows a net income of $64,596,848 on sales of $1,187,784,024 and lists assets in excess of $800,000,000. The company has paid dividends regularly every year since 1924.

Firestone's expansion of facilities outside of Akron began as early as 1919 when the Firestone Tire & Rubber Co. of Canada, Ltd., in Hamilton, Ontario, was incorporated. During the past decade, a total of 13 facilities have been added to the Firestone complex. Within the past five years, the company has spent $274 million, and this year has appropriated an additional $120 million for construction of new plants and modernization of existing plants.

Although tires have constituted Firestone's principal product for 60 years, the firm manufactures and markets approximately 12,000 other products in six major industrial fields—rubber, metals, plastics, synthetics, textiles and chemicals.

B. J. Skowronski

Named Sales Manager

► Benjamin J. Skowronski has joined National Polychemicals, Inc., Wilmington, Mass., as manager, Midwestern sales, and will have his headquarters in Akron, Ohio. Mr. Skowronski, who was formerly technical service representative for the Neville Chemical Co., Pittsburgh, Penna., holds a degree in chemical engineering from New York University. His past experience also includes tire compounding development with Armstrong Rubber Co., production supervision of synthetic rubber for the Naugatuck Chemical Division of U. S. Rubber Co., and process control operations for the National Aniline Division of Allied Chemical Corp. He was also technologist for the R.F.C. Synthetic Rubber Division.

Taccone Names Adam

► Lloyd C. Adam has joined the Taccone Corp., North East, Penna., as manager of the Rubber and Plastics Machinery Division. He has been in rubber and plastics machinery sales for 17 years, serving with Erie Engine & Manufacturing Co., Erie, Penna., as sales manager and executive vice-president.

DuPont Neoprene Plant On Stream in Ireland

► An $11 million neoprene plant was officially opened by E. I. du Pont de Nemours & Co., on July 26 at Londonderry, Northern Ireland. The plant, operated by a subsidiary, Dupont Company (United Kingdom) Ltd., and the first manufacturing facility to be put into operation by the subsidiary, has an annual production capacity of 50 million pounds of neoprene. Speaking at the opening, Walter S. Carpenter, Jr., chairman of the board of directors of E. I. du Pont de Nemours & Co., Wilmington, Del., said that the eventual merger of the two great European trade areas would greatly enhance the prospect of adding new production facilities for other DuPont products at the Maydown Works.

Construction of the plant was started early in 1958 on a 365-acre site under the supervision of 18 construction men from DuPont's Engineering Department. In addition, 35 operating personnel were temporarily transferred from the United States parent company to get production started. Even though the plant has yet to reach its maximum capacity, plans were announced for a 20 per cent expansion of production due to the growing demand for neoprene in the European market, the company states.

According to Mr. Carpenter, DuPont is spending "between $40 and $50 million" in a major expansion into the European market. An Orlon plant of 12 to 15 million pounds annual capacity is under construction in Holland. A paint factory employing 180 persons is being built in Belgium, while in France the company is contracting with established chemical firms for the manufacture of agriculture chemicals. In Germany, DuPont has acquired a 26 per cent interest in Pigment Chemie, a new company formed to make titanium dioxide pigments.

Sun Debentures Offered

► A public offering of debentures and shares of Sun Rubber Co., Barberton, Ohio, has been made as part of a financing program for Sun Rubber. The offering of $1 million of 6 per cent subordinated debentures, due April 1, 1975, and 100,000 common shares, is in the form of $100 units. Each unit consists of $100 principal amount of debentures and 10 common shares.

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Helio® Red		■	■
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Permanent Red	■	■	■
Permanent Carmine	■	■	■
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Heliogen Green	■	■	■
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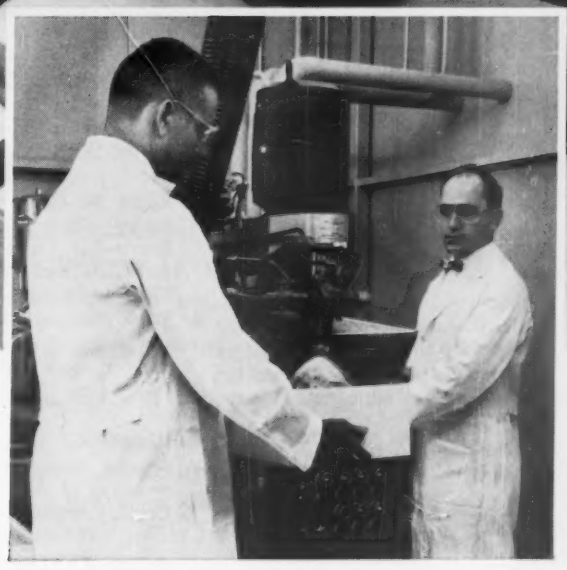

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070

Names in the News

John P. B. Jones has been appointed sales representative for the Pigment & Chemical Co. Ltd., Montreal, Canada, in British Columbia and Alberta.

Arthur E. Juve, director of technical services at the B. F. Goodrich Co. research center in Brecksville, Ohio, is the author of an article on rubber products manufacture which will appear in the McGraw-Hill *Encyclopedia of Science and Technology*.

Andrew C. Lyon has been elected a vice-president of the Standard Products Co., Detroit, Mich., and is to succeed **W. Howard Thourlby,** vice-president, sales, who anticipates retiring within the next year.

Richard C. Shower, formerly technical foreman of the B. F. Goodrich Chemical Co. synthetic fiber pilot plant, has been appointed cost and economics analyst for Goodrich-Gulf Chemicals, Inc., Cleveland, Ohio.

Lon E. Welch, a representative for Oakite Products, Inc., New York, N. Y., has been transferred to Kokomo, Ind., where he replaces **Daniel B. Lamb,** recently appointed manager of the company's Detroit division; and **George E. Park** has been assigned to Springfield, Mo.

Wendell Guy has been appointed to the newly created position of staff manager in charge of methods engineering and quality control at Moxness Products, Inc., Racine, Wisc.

John Franklin, secretary-treasurer of Whittacker, Clark & Daniels, Inc., New York, N. Y., is celebrating his 50th year with the company.

Elmer R. Gibson, manager of purchasing at Seiberling Rubber Co., Akron, Ohio, was honored upon his retirement by a luncheon of the Rubber Chemical Salesmen's Association of Akron.

J. W. Keener, president of the B. F. Goodrich Co., Akron, Ohio, has been elected to the Board of Directors of the Economic Club of New York for a four-year term.

Dr. Leland M. White, director of research and development for U. S. Rubber Co., New York, N. Y., received an honorary Doctor of Science degree from Ottawa University, Ottawa, Kans.

Dr. Johnstone S. Mackay has been named director of the Research and Development Department of Pittsburgh Chemical Co., Pittsburgh, Penna., and will also be responsible for co-ordinating the research group's programs with over-all company plans.

Henry J. Jackelen, who has been comptroller of the Brazilian subsidiary of the Firestone Tire & Rubber Co., Akron, Ohio, has been appointed managing director of the Firestone plant in Sao Paulo, Brazil.

Fred L. Sharpe, Jr., has been named vice-president and director of sales at Heresite & Chemical Co., Manitowoc, Wisc.

Edgar M. Cullman, a director and senior vice-president of Cullman Bros., Inc., tobacco growers and marketers, and a partner of Cullman Brothers, members of the New York Stock Exchange, has been elected to the board of directors of the U. S. Rubber Reclaiming Co., Inc., Buffalo, N. Y.

Charles G. Wyman has been appointed technical assistant to the president of the Lee Rubber & Tire Corp., Conshohocken, Penna.

Rodney L. Perkins has been elected secretary of the Seiberling Rubber Co., Akron, Ohio, succeeding Willard P. Seiberling who has retired.

William St. John, formerly with the Rubber Division of Hewitt-Robins, Inc., Stamford, Conn., has joined the Pawling Rubber Corp., Pawling, N. Y., as silicone rubber products sales manager.

Dr. Robert W. Eldridge, a member of the company's Patent and Information Service Department, has been appointed a senior research scientist at the Wayne, N. J., Research Center of U. S. Rubber Co.

C. B. Copeman

Awarded Hancock Medal

► The Council of the Institution of the Rubber Industry, London, England, has awarded the Hancock Medal for 1960 to C. B. Copeman, chairman of Maclaren and Sons Ltd., publishers of technical and trade journals and technical books, for outstanding services to the Institution and the rubber industry. Maclaren publishes *Rubber Journal* and *International Plastics*. Mr. Copeman became a director of Maclaren in 1919, was made vice-chairman in 1927, and became chairman of the company in 1951. He joined the Institution of the Rubber Industry in 1921, the year it was founded. He has served on the Council of the IRI since 1921, except for the years of rotational retirement, as well as on the Executive and Finance Committees. He was a vice-president of the Institution from 1957-59.

Retires from Seiberling

► Willard P. Seiberling, secretary of Seiberling Rubber Co., Akron, Ohio, has retired from the company after 39 years of service. He continues as a member of the board of directors. A graduate of Princeton University, Mr. Seiberling began his industrial career in 1915 at Goodyear Tire and Rubber Co., Akron, and was manager of the company's Aeronautics Department for four years. He joined Seiberling in 1921, shortly after his father, F. A. Seiberling, left Goodyear to found the new company. He started as manager of accessories and repair materials sales. In 1944 he was named company secretary, and six years later he was elected to the board of directors.

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Boston Summer Outing Held At Andover Club

► The Andover Country Club, Andover, Mass., was the scene of the 24th Annual Summer Outing of the Boston Rubber Group, held on June 17 with 705 members and guests in attendance. The day's activities included 9-hole and 18-hole golf tournaments, a putting contest, horseshoes, darts, softball, tub and ball, and horse race. A lobster dinner served and eaten under a big-top tent concluded the outing.

Prize winners for golf and the other events were: *18-Hole Golf Tournament, Low Gross,* A. Nelson (Goodrich Footwear), R. Stimets (United Carbon, W. A. Maguire (United Carbon), C. L. Lyons (Lyons Chemical), J. Blonstrom (General Latex & Chemical); *Low Net,* P. Jamieson (Macalaster - Bicknell), R. Mason (Cabot), F. Catalfanno (Bristol Mfg.), E. Brown (Naugatuck Chemical), G. Dragotta (Humko Products); *Kickers Handicap,* W. Platt (Columbia Southern), H. Connors (Diamond Alkali), C. Ford, H. Collyer (Cabot), A. Bryant (Columbian Carbon), E. Opie (Cabot), H. Duston (Raffi & Swanson), L. Longworth (Monsanto), R. Bobbitt (R. T. Vanderbilt), R. Dean (Woburn Chemical), J. Beals (Raffi & Swanson), J. Kubison (Kessler Chemical);

Nearest to Pin (133 yards), Philip Blanchard (Blanchard Chemical) and E. M. Danenburg (Cabot); *Most Sixes,* J. Kozlowski (Borden Co.); *Most Sevens,* R. B. Huber (R. B. Huber Engineers); *High Gross,* B. Blagman (Malden Mills); *High Net,* A. Grindle (Compo Shoe); *Longest Drive,* R. Harrington (Raffi & Swanson);

Other Prize Winners

Nine-Hole Golf Tournament, Low Gross, C. K. Mullin (C. K. Mullin Co.) and J. Young (Goodrich Footwear); *Low Net,* Arthur Ross (American Biltrite) and H. Sheehan; *Kickers Handicap,* E. A. Benchley (Angier Adhesives), J. Deasy (G-E), A. Finley (Royce Chemical), R. Bonner (Eastman Chemical); *High Gross,* D. Snow (Goodrich Footwear); *High Net,* G. Covington (Phillips Chemical);

Darts, A. Davis (Columbian Carbon), M. Lewis (Compo Shoe), G. Wright, F. CiBaggis (Farrington Textile), M. Perdigao (Cabot); *Tub and Ball,* R. O'Brien (Goodall-Sanford), H. Doyle (Summit Chemical), F. Balukonis (Stowe & Woodward), John Foley (Stowe & Woodward), R. Hofferbert (Pellon Corp.); *Putting Contest,* H. Kitchens (Sessions-Gifford), J. Brinetti (Avon Sole), B. Stone (Kleistone Rubber), H. H. Laetsch (Goodall-Sanford);

Horseshoes, Team of Philip Blanchard (Blanchard Chemical) and J. C. Cameron (Goodrich Footwear); *Winning Baseball Team,* A. Messier (Cabot), R. Bartlett (Cabot), L. Shea (Cabot), A. Mionchuk (United Shoe Machinery), G. Caley (United Shoe Machinery), J. Haigins (Allied Chemical), A. Macdonald (DuPont), A. Stepnowsky (Quabog Rubber), R. Shinney (Rubber Corp. of America), A. Rosenberger (Boston Woven Hose).

Boston Rubber Group officers and Outing Committee members, left to right: Harry Atwater (Malrex Chemical), permanent historian; George Hunt (Simplex Wire), outing chairman; John Hussey (Goodyear Chemical), group secretary-treasurer; Bob Loveland (R. T. Vanderbilt), group director; George Herbert (Tyer Rubber), group vice-chairman; Jim Breen (Barrett & Breen), group chairman; Ted Freeman (Stedfast Rubber), softball sports director; Tom Weaver (Columbian Carbon), putting contest director; B. H. Capen (Tyer Rubber), national director; Bill King (Acushnet Process), group past-chairman. Outing committee members not in photographs: Bill Platt (Columbia Southern), golf tournament director; John Ledden (DuPont), dart game director; Ray Camelio (Boston Woven Hose), horseshoe director; Dick Peterson (Hodgman Rubber) tub and ball game director.

Goodrich Expands Plant

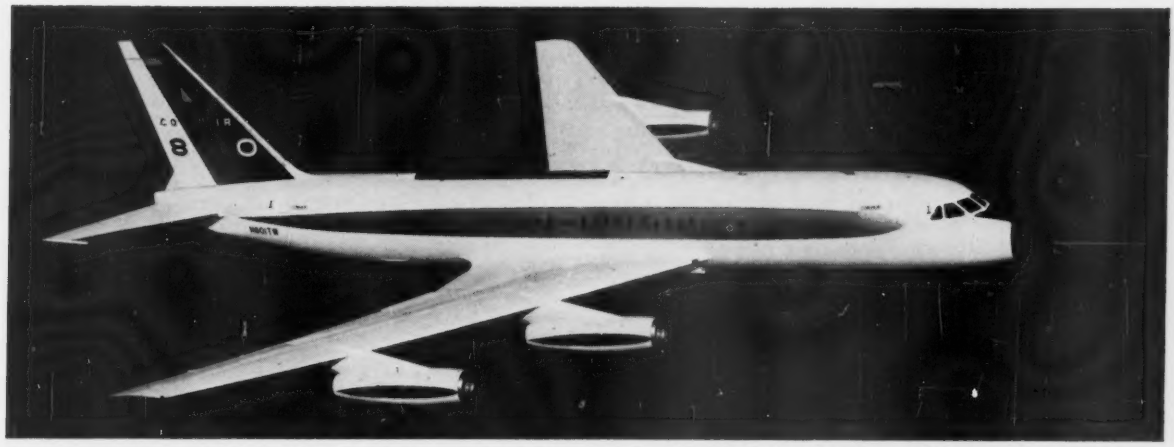
► B. F. Goodrich Tire Co., Akron, Ohio, has announced plans for the tenth expansion of its Miami, Okla., plant since it was built in 1945, in order to produce passenger tires for Sears Roebuck and Co. The expansion, scheduled for completion in 1961, will include facilities for production of white sidewall tires for the first time in the plant's history.

Overseas Units Join

► Phoenix Gummiwerke A.G., Hambourg-Harbourg, Germany, an associate of the Firestone Tire and Rubber Co., Akron, Ohio, and Industrie du Caoutchouc Souple, S.A. (Flexible Rubber Industry, Inc.) Pont-de-Cheruy, France, have announced a plan for technical and commercial collaboration in all areas other than that of tire production. I.C.S. and the organizations affiliated with it are producing vulcanized rubber soles, pipes and various articles of a technical nature, as well as regenerated rubber, in its three plants at Pont-de-Cheruy, Lyon and Paris. Phoenix Gummiwerke is a major German producer of shoes and rubber products.

Huber Names Distributor

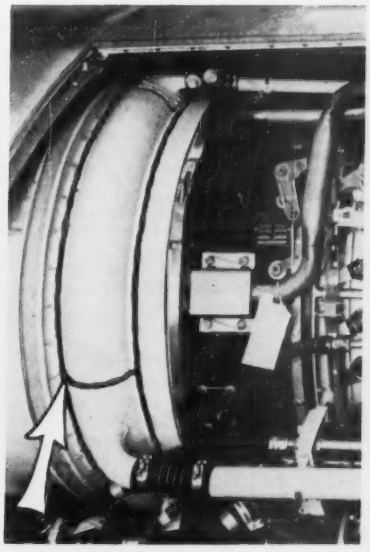
► J. M. Huber Corp., New York, N. Y. has named R. T. Freeman Co., distributor for its series of Huber kaolin clay extender and Zeolex synthetic silica pigments to the paint, varnish, printing ink, plastics and specialty processing industries in the New England states, with the exception of Southern Connecticut. The Freeman Co. maintains a sales office in Hingham, Mass.



Flex-support door seal designed by Convair is typical of advance design features of the 880. General Electric silicone rubber—with its outstanding resistance to temperatures, ozone and aging—is used extensively on the General Dynamics Convair 880.

General Electric silicone rubbers meet rigorous requirements of new Convair 880

Unique silicone rubber door seal incorporating spring steel flex-support, a fail safe feature that eliminates the danger of seal collapse. General Electric SE-555, with twice the strength of regular silicone rubber, easily withstands flexing of integrally molded steel support. Over 600 wiping action and pressure cycling tests prove seal will meet all operational requirements.



G-E RTV high-temperature sealant is used extensively in pylon and pod assemblies which hold G-E CJ805-3 jet engines. Liquid RTV (room temperature vulcanizing) silicone rubber is easily applied and cures without heat. RTV has excellent bond strength, good physical properties, plus resistance to temperature extremes (600°F and above), ozone, weathering, moisture, aircraft fuels and solvents.

Now available: New G-E Silicone Rubber Selector. This guide will help you quickly select the right silicone rubber to best meet your application requirements. In it you will find important data on applications, primary classes, typical properties and specifications. Tells how to specify the grade you want by AMS, ASTM or military specifications. Write for your free copy.

GENERAL ELECTRIC

Section HH-911 Silicone Products Department, Waterford, N. Y.

Natural Rubber Producers Hold Symposium on Failure Phenomena

The Natural Rubber Producers' Research Association held a two-day symposium, "Fundamentals of Failure Phenomena in Rubbers," on July 7 and 8 at its Welwyn Garden City laboratories, outside of London. Sixty scientists and technologists heard leading research figures discuss their work with failure phenomena in rubbers. The symposium was opened by Dr. Leslie Bateman, director of the Association, who noted the special position in the elastomer family occupied by "real natural rubber." In addition, he stated that the rubber producers of Malaya recently reorganized and expanded their research activities. The British Rubber Producers' Research Association, Welwyn Garden City, will be known as the Natural Rubber Producers' Research Association, and the Natural Rubber Development Board, London, England, will be known as the Natural Rubber Bureau. Summaries of the papers heard at the meeting follow:

BASIC FACTORS DETERMINING TEAR RESISTANCE, by L. Mullins, Ph.D. An aid to standardization and objective measuring of strength qualities has been found in the quantitative description of the tear quality of a rubber in terms of a characteristic tearing energy related to the elastic energy stored in a highly strained zone at the tip of the growing tear. The tearing energy, most of which is dissipated as heat, varies with the type of rubber, the nature of the compound, and the rate and temperature of tearing. With gum vulcanizates which do not crystallize on stretching, there is a simple relationship between tearing energy and hysteresis in that rubbers with higher hysteresis possess higher tear strength. In connection with the effect of both crystallization and the presence of reinforcing fillers on strength, it now appears that the resultant increase in strength reflects the creation of dissipative processes which are akin to increased hysteresis. This inter-relation between hysteresis and strength provides a determining feature in the design of rubbers for particular applications.

RUPTURE PROCESSES DURING CUT-GROWTH AND FLEX-CRACKING, by A. G. Thomas, M.A. There is an important difference in the behaviour of crystallizing and non-crystallizing rubbers in dealing with the failure of rubber due to cut-growth or flex-cracking on repeated cyclic deformation. In simple tearing under a steady load there is virtually no growth of a tear in a crystallizing rubber if the load is less than a certain critical value, but the cut grows steadily with time in the case of a non-crystallizing gum rubber. However, if the same load is repeatedly applied in a cyclic way, cut-growth occurs progressively in both types of rubber. Both cut-growth and flex-cracking behaviour can be described in terms of a simple tearing process. In flex-cracking, the "cut" grows from small flaws initially present in the rubber, and the effect of such flaws on the apparent tensile strength of rubbers has been established and the possibility of describing various rupture properties is apparent. The application of the tearing energy approach to some aspects of the rupture of cellular rubbers was also discussed.

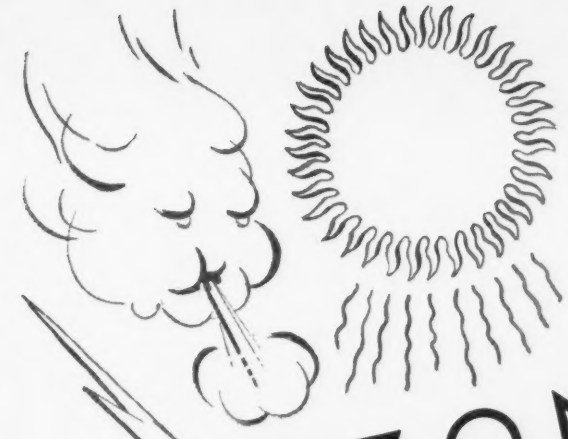
FATIGUE AS A CUT-GROWTH PHENOMENON, by P. B. Lindley, B. Eng. The cyclic cut-growth rate of natural rubber vulcanizates can be predicted to be proportional to the square of the tearing energy at the tip of the cut. In simple extension, where the tearing energy is proportional to the length of the cut and the elastic strain energy in the bulk of the test-piece, the cut-growth relationship leads to a simple expression for the fatigue life of tensile test pieces under repeated cyclic deformation. Under service conditions, the factors which seriously affect the fatigue life of any natural rubber compound are the magnitudes of the surface defects and the maximum elastic strain energy. In contrast, non-crystallizing SBR gum stock was found to have a frequency and temperature dependent cut-growth rate proportional to the fourth power of the tearing energy, making its fatigue life more dependent on cut length, elastic strain energy, frequency and temperature.

PHYSICAL ASPECTS OF ANTI-OZONANT FUNCTIONS, by M. Braden, B.Sc., and D. Barnard, Ph.D. Two physical parameters characterize the cracking process: (1) a critical elastically stored energy necessary for crack initiation to occur, and (2) a characteristic rate of crack growth. A number of additives retard the rate of crack growth of natural rubber, although the maximum retardation of rate yet observed is only threefold. The rate of crack growth in the more ozone resistant polymers is at the most a tenth of that for natural rubber. The most important class of practical anti-ozonants comprise the N.N′ di-alkyl-p-phenylenediamines, as, in contrast to the additives referred to above, these substances increase the critical energy necessary for crack initiation — the extent of the increase depending on the ozone concentration — to an upper limit of ozone concentration. Provided this limit is not exceeded, the critical energy may be increased 1,000-fold. It is indicated that the scavenging of ozone by the anti-ozonant is not a tenable protective mechanism, but that the tendency of the anti-ozonant to become ineffective at high ozone concentrations may reflect that direct action of ozone on the anti-ozonant may be an undesirable side effect. Finally, the possibility of the chemical intervention of an anti-ozonant in the fission process is discussed in the light of evidence at present available.

STRESS RELAXATION STUDIES OF OXIDATIVE AGING, by J. R. Dunn, D. Phil. Changes in a vulcanizate network can best be followed by measurements of stress relaxation, and both the amount of scission and the amount of crosslinking occurring during aging can be assessed. Stress relaxation measurements have been used to study details of chain-breaking and chain-making reaction in vulcanizates, and to investigate the mode of action of antioxidants. If purified by acetone extraction before and after vulcanization, "sulphurless" vulcanizates including peroxide, radiation, and phenol-formaldehyde resin cross-linked natural rubber or synthetic **cis**-polyisoprene, and also natural rubber cross-linked with tetramethylthiuram disulphide, degrade autocatalytically by random scission of the polyisoprene chains. Sulphur-accelerator vulcanizates, on the other hand, do not degrade autocatalytically and scission appears to be directed at the crosslink site, although the crosslinks themselves are not severed. Stress relaxation measurements have shown that dithiocarbamates and certain similar compounds, protect sulphurless vulcanizates against the action of heat, and, in some cases, of light also.

NEW APPROACHES TO THE PROTECTION OF NR AGAINST OXIDATIVE AGING, by S. G. Fogg, B.Sc. The compounding of natural rubbers has been re-investigated with a view to improving their heat resistance. The starting point was the TMT-ZnO curing system. Further protection can be conferred by the use of selected antioxidants and by imidazole derivatives. The choice of filler, vulcanizing system, and protective agents, will depend on the properties which it is most desirable to retain for a particular application, and different compounds have been developed for maximum retention of various properties or groups of properties. It has been found possible to minimize various undesirable features of the thiuram disulphide curing system. The performance of these compounds is such that natural rubber can be satisfactorily used for products operating in the temperature range 100–125° C.

THE MECHANICS OF OZONE CRACKING, by A. N. Gent, Ph.D. Studies of the growth of single cracks in a thin rubber sheet exposed to ozone have revealed two characteristic factors governing ozone attack: (1) a minimum of "critical" state of strain necessary for crack growth to occur at all; (2) a well-defined rate of growth when the critical state is attained or exceeded. The critical condition appears to reflect an energy requirement for growth of about 60 ergs/cm² of newly-formed surface. This low value suggests that the critical state is that at which the **surface** energy necessary for crack growth is provided in the form of stored elastic energy. The rate of crack growth is found to be dependent on the chemical nature of the polymer and on its internal viscosity.



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(anti-ozonant) (anti-oxidant) (anti-suncheck agent) (costs less)

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To protect rubber goods against weather and flex cracking, a unique anti-ozonant, anti-oxidant and anti-suncheck agent, **OZONO** is now being offered to the rubber industry.

Manufactured by a new special process, **OZONO** affords better ozone, oxygen and sun cracking protection than mixtures of commercial anti-ozonants and waxes used separately. Tests show that an equal degree of protection is obtained at **OZONO** concentrations at appreciably smaller costs than with the amounts of commercial agents normally used.

Showing excellent protective value against heat, oxygen, fatigue flexing, copper deterioration and ozone cracking, **OZONO** is made in a form which simplifies its incorporation into rubber stock in an internal mixer or on a mill.

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OZONO - - - *another triumph from Beacon Research*

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Financial News

Industrial Rayon

► Six months ended June 30: The company reported a net loss of $1,406,427, or 76c per share, as compared to a loss of $555,858, or 30c per share, for the comparable period of 1959. Net sales slumped to $24,935,123, from $31,149,749 for the like period a year ago. In his report to the stockholders, Frederick L. Bissinger, company president, said that operations in the second quarter were adversely affected by curtailment of production and regrouping of facilities for the manufacture of viscose fibers and by the startup expenses incurred in increasing production of filament textured nylon yarns and polypropylene fibers, as had been anticipated. He added, however, that "a falling off in the market demand for viscose fibers makes it unlikely that we will realize our earlier hopes for approaching a break even point in the third quarter and for profitable operations in the fourth quarter."

Armstrong Rubber

► Nine months ended June 26: Consolidated net income totaled $3,272,454, equal to $1.92 per share, compared to $3,645,068, or $2.14 in the comparable period of 1959, adjusted to include sales of the now wholly-owned Armstrong Tire and Rubber Co. Consolidated net sales amounted to $80,939,325, compared to $84,035,518. Consolidated net income includes a net increase in dividend income from the company's 28.6 per cent owned affiliate, Copolymer Rubber & Chemical Corp., amounting to $101,420. Frederick Machlin, company president, said results had been influenced by severe competition in the foam rubber industry and high material costs which affected the sales and earnings of the Armstrong-Norwalk Rubber Corp., a subsidiary.

Stauffer Chemical

► For 1959: Net earnings totaled $22,221,603, or $2.41 per share, as compared to $18,021,487, or $1.95 per share, for 1958. Net sales amounted to $228,076,639, compared to $211,883,885 for 1958.

Goodrich

► Six months ended June 30: Net income for the period dropped to $18,177,093, equal to $2.02 per share, as compared to $19,612,490, or $2.18 a share, for the comparable period last year, in spite of a sales rise to $403,820,831, a gain of 5.3 per cent over the $383,369,949 reported this time last year. The current six months sales period is the highest such period in the company's history. Not included in the net income is company equity in net income retained by unconsolidated subsidiary and associate companies amounting to $1,350,000, or 15c per Goodrich share, as compared to $1,100,000 or 12c for the previous year. Higher natural rubber and employment costs coupled with low competitive pricing of replacement tires and some other products, have adversely affected earnings this year, said company President J. W. Keener.

United Carbon

► Six months ended June 30: Net income was $3,634,000, equivalent to $2.85 per share on the increased shares, against $3,503,000, or $2.84 a year ago. A drop in sales, to $29,524,000, from $31,412,000 during last year's first half, was attributed to lower sales of carbon black-synthetic rubber masterbatch. The company expects increased synthetic rubber sales for the second half as a result of the introduction of a new line of masterbatch products.

Sheller Manufacturing

► Quarter ended March 31: Net income totaled $524,043, or 55c per share, as compared to $381,935, or 40c per share for the like period of 1959. Net sales were $13,888,497, against $11,330,171 for the first quarter of 1959.

National Rubber

► Quarter ended March 31: Net income totalled $45,000, equal to 21c per share, contrasted to $54,000 or 26c a share for the like period of 1959. Sales climbed to $6,635,000 for the period, from $2,604,000 in the same period of 1959.

U.S. Rubber

► Six months ended June 30: Net income dropped 2.4 per cent to $18,505,198, with earnings equivalent to $2.77 a share, from last year's first half figure of $18,956,286, or $2.85, although sales rose slightly to establish a new first half record for the company. Sales totaled $510,188,647, as compared to $508,864,623 for the like period of 1959. Net income for the first half of 1960 included special credits of $1,350,000, or 24c a common share, reflecting a net gain from the sale of the company's plant in Fort Wayne, Ind., and from prior years' tax accruals which are no longer required, according to H. E. Humphreys Jr., chairman of the board. Earnings for the period, he said, were adversely affected by higher costs for labor and natural rubber, while price competition in replacement tires and some other commodities also tended to reduce profit. He also noted higher commercial expenses as a result of efforts to widen distribution.

Dayton Rubber

► Quarter ended January 31: Net income amounted to $364,247, equal to common share earnings of 30c, compared with $362,953, or 32c per share, for the like period a year ago. Net sales for the quarter totaled $22,461,186, compared with $19,756,402 last year.

Triangle Conduit

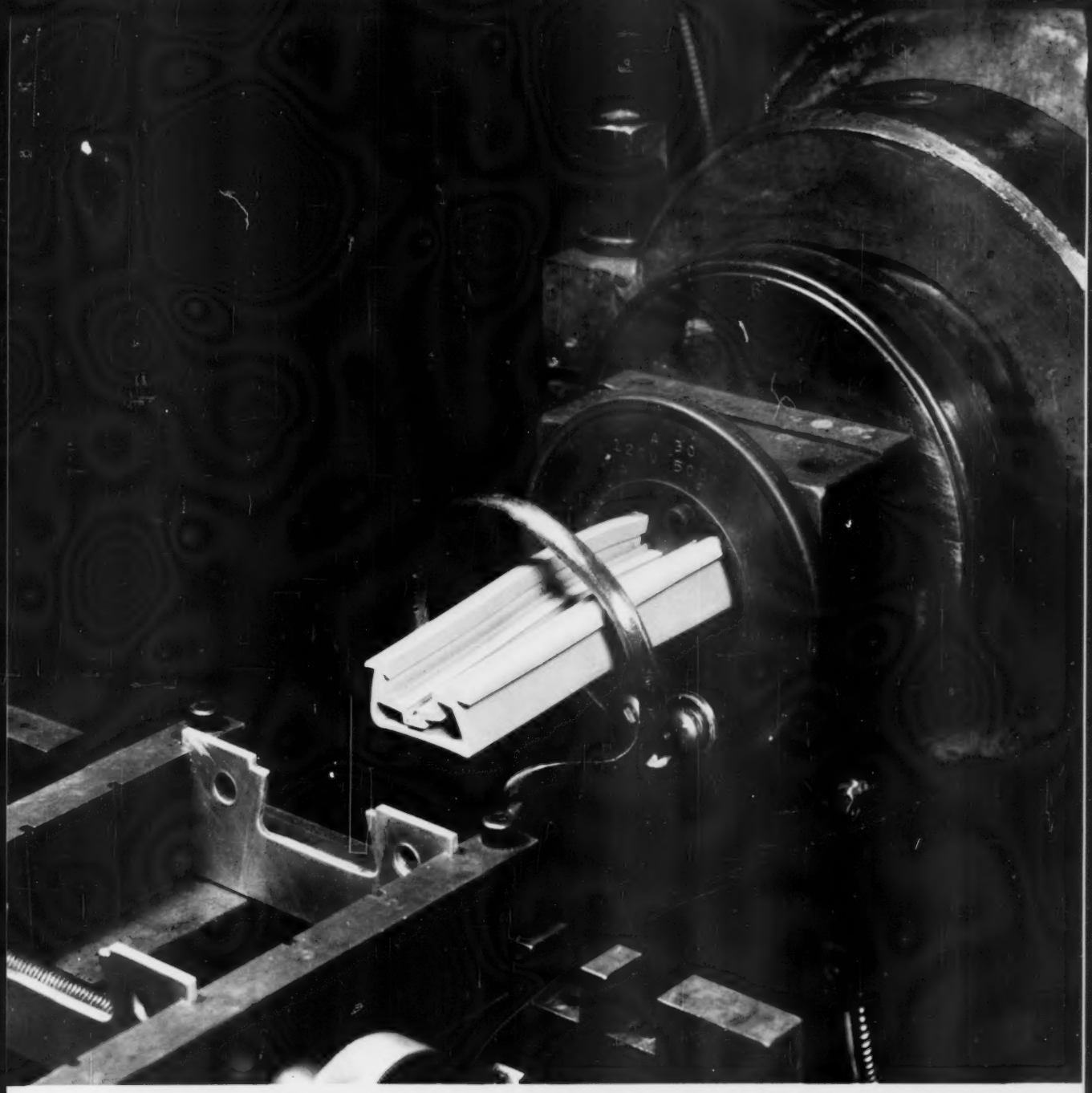
► Quarter ended March 31: Net income dipped to $353,082, equal to 26c a share, from last year's first quarter figure of $601,784, equal to 44c a share. Net sales dropped to $11,966,250 from $14,949,258 for the like period of 1959.

Lee Rubber & Tire

► Six months ended April 30: Net income for the period was $217,676, equal to 25c per share, contrasted to $653,067, or 76c per share, for the like period a year ago. Net sales were $21,483,917, compared to $24,396,553.

Kleinert Rubber

► For 1959: Net income for the year climbed to $741,345, equal to $2.51 per share, contrasted with $655,400, or $2.20 per share in 1958. Net sales for the year reached $14,435,942, comparable to $13,423,734 for 1958.



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A substantial improvement in the processing of oil-resistant rubber stocks and improved impact strength in PVC or styrene acrylonitrile compounds is now possible through the use of Polysar Krynac 804.

This new Krynac is a cross-linked polymer of butadiene acrylonitrile and divinyl benzene and when used in rubber compounds produces a marked improvement in the processing of extruded, moulded and calendered goods. Dimensional stability is improved and a smoother finish is obtained on extrusions and calendered applications, shrinkage is reduced and problems of die swell are greatly minimized.

For details of POLYSAR KRYNAC 804 write to: Marketing Division, Polymer Corporation Limited, Sarnia, or Polymer's distributor in this area.

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POLYSAR KRYNAC 804 doubles extrusion rate... cuts mill shrinkage by 50%

COMPOUND	A	B	C	D	E
Polysar Krynac 800	100.0	75.0	50.0	25.0	—
Polysar Krynac 804	—	25.0	50.0	75.0	100.0
MILL SHRINKAGE					
Linear shrinkage (with grain) %	45	40	20	10	5
EXTRUSION PROPERTIES					
(A) Garvey Die					
Rate (in./min.)	28	37	50	66	70
Ratio (gm./in.)	4.2	3.3	2.3	1.8	1.7
(B) ⅛″ Die					
Rate (in./min.)	150	205	290	365	390
Die swell (%)	120	80	30	5	2

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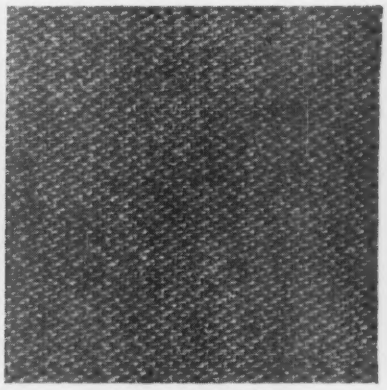
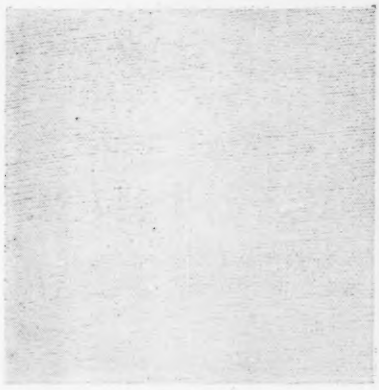
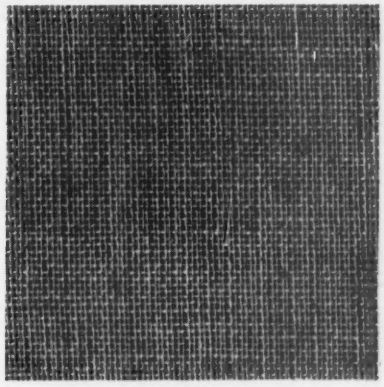


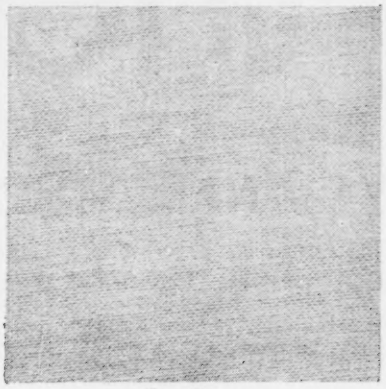
Cotton Broken Twill



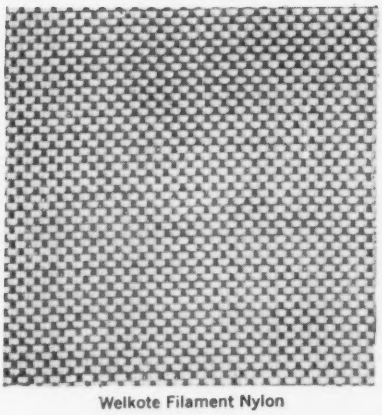
Spun Dynel



Cotton Chafer

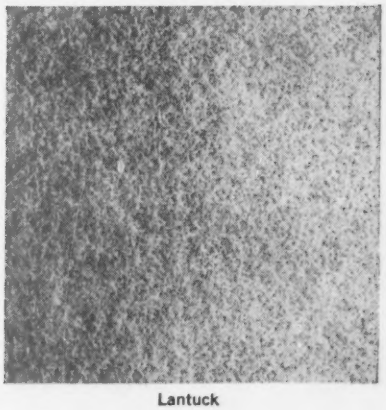


Spun Rayon



Welkote Filament Nylon

Knit Kote



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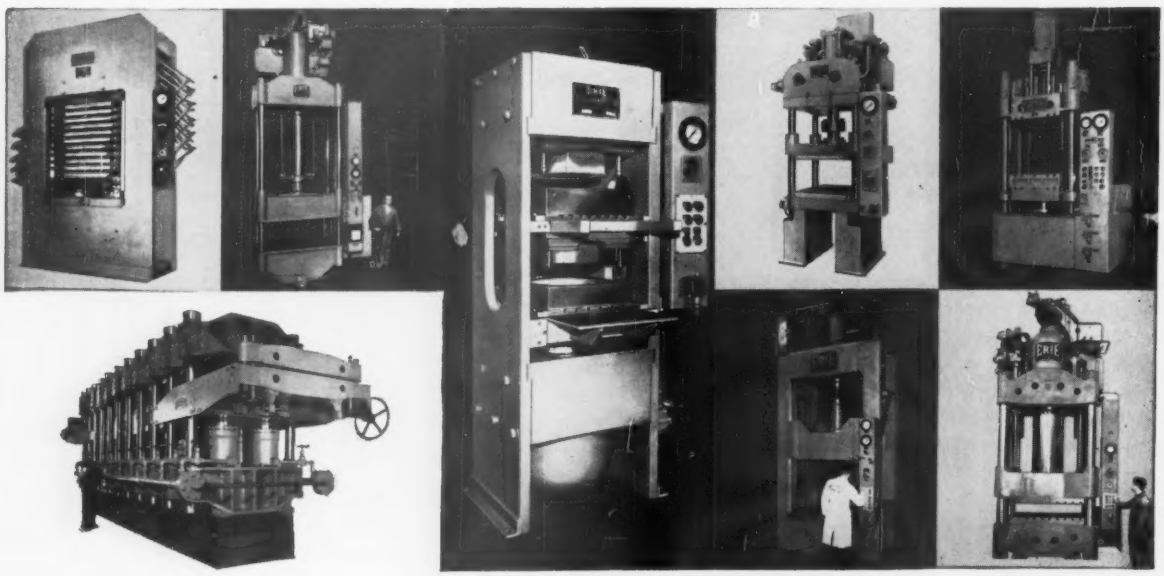

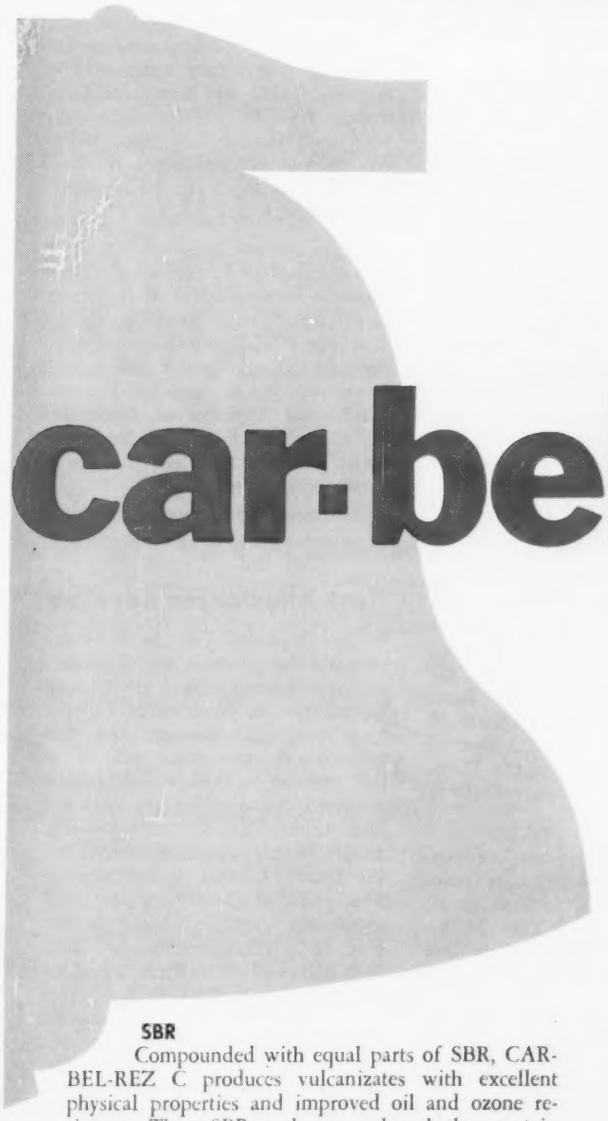

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CAR-BEL-REZ C is a thermoplastic, oil-resistant resin which is polymerized to a relatively high molecular weight for optimum physical properties in elastomeric and plastic compositions. It disperses easily without high-temperature mixing.

CAR-BEL-REZ C is made by THE CARTER BELL MFG. CO.

SBR

Compounded with equal parts of SBR, CAR-BEL-REZ C produces vulcanizates with excellent physical properties and improved oil and ozone resistance. These SBR stocks, even though they contain both resin and process oil, work easily on the mill without becoming soft and sticky. The "free sulphur" (polysulphide) reduces the accelerators needed in the recipe. SBR vulcanizates containing CAR-BEL-REZ C can be made to meet the basic requirements for oil-resistant rubber, type S, Class SC. The high reinforcing action of CAR-BEL-REZ C greatly improves the physical properties of non-black SBR stocks.

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Up to 20 parts of CAR-BEL-REZ C added to neoprene stocks will not materially change the physical properties. The resin plasticizes neoprene, while giving good flex life, decreasing the tendency to stick to mill and calender rolls, and improving bin aging of raw stocks. The addition of 50 parts CAR-BEL-REZ C will produce superior ozone resistance.

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West Coast News

► The TLARGI Rubber Technology Foundation sponsored by the Los Angeles Rubber Group, Inc., and the University of Southern California, will be co-sponsors of rubber technology courses to be given at the University during the Fall semester.

The four Chemical Engineering courses are: 015a — Basic Rubber Technology (non-credit), an introduction to technology, compounding and production; 442—Rubber Technology I (2 units credit), a lecture course on technology of natural and synthetic rubber including their chemistry, structure, production, testing, compounding, processing and uses; 443aL—Rubber Technology Laboratory I (2 units credit), unit operations of the rubber industry, including compounding, mixing, extruding, curing, preparation of test samples, and testing; 445 L—Latex Technology (2 units credit), colloid chemistry and basic technology of natural and synthetic latices including preparation, compounding, processing and manufacture of foam rubber, dipped goods, latex thread, adhesives and coatings.

Full information may be obtained from Dr. E. G. Partridge at the University of Southern California.

► Three chemists have been added to the rubber research staff of Golden Bear Oil Co., Bakersfield, Calif. They are W. R. Mitten, Paul Ishmael, and Troy E. Mullins.

Mr. Mitten graduated from Kent State University in 1937. He was an analyst at Babcock and Wilcox Co., Barberton, Ohio, and from 1946 to 1956 he was an analyst at the University of Akron Government Laboratories, evaluating polymerization ingredients, polymers, and extender oils for oil-extended rubbers. He was instrumental in devising new test procedures, among them an ozone test for polymers. Other projects connected with the Government's synthetic rubber program, under his direction, were low temperature transition studies and peroxide stability investigations. Most recently, he was with Olin Mathieson Chemical Corp., in Niagara Falls.

Mr. Ishmael, who attended the University of Oklahoma, was with the Oklahoma Testing Laboratories and Sohio Petroleum Co. He spent three years with AFC, Edison California, before joining Golden Bear. Mr. Mullins is a 1958 graduate of Pasadena College, and he served as an analytical chemist at the U. S. Army Chemical Corps., Dugway Proving Grounds.

► Edward F. Currier has been appointed Seattle district sales manager of the U. S. Tires Division of U. S. Rubber Co., New York, N. Y., succeeding Robert Walker who has been promoted to the post of Southwest regional manager. The Seattle district is comprised of Washington, nearly all of Oregon, parts of Idaho, and the major areas of Montana.

W. R. Mitten, Paul Ishmael, and Troy E. Mullins, left to right, who have been named to the rubber research staff of Golden Bear Oil Co.

► George Meyer has been appointed manager of manufacturing of Parker Seal Co., Culver City, Calif. He will be responsible for all the company's manufacturing facilities in Culver City and East Los Angeles, Calif., and Berea and Lexington, Ky. Mr. Meyer, who has been with Parker Seal since 1959, was general superintendent at Warner and Swasey, Inc., Cleveland, Ohio, for 12 years.

► Leland C. Launer has been named a vice-president of Interstate Engineering Corp., Anaheim, Calif., in charge of Hadco Engineering Co., Autronics Corp., Utah Research and Development Co., and the Electro-Mechanical Division of Interstate. ing Co., a subsidiary of Interstate He is president of Hadco Engineer-Engineering Corp.

Test Allowances Revoked

► The Department of the Navy announced that effective August 26 certain specification tests in government laboratories at government expense have been discontinued, and that such qualification tests will be at the expense of the manufacturer. Involved are qualification tests for Specification MIL-G-22004 (Ships), gasket, high temperature, and lighting fixture; Class I of Specification MIL-G-21610 (Ships), gaskets, heat exchanger, various cross section ring, and synthetic rubber; Specification MIL-G-21569 (Ships), gaskets, Cylinder Liner Seal O-Ring, synthetic rubber; and Specification MIL-G-22050 (Ships), gasket and packing material, synthetic rubber, nonflammable, hydraulic fluid resistant. Copies of the specifications may be obtained from the Commanding Officer, Naval Supply Depot, 5801 Tabor Ave., Philadelphia 20, Penna., Attn: CDS.

Foam Program Opened

► Member companies of the Latex Foam Rubber Council have adopted a tag program to aid consumer recognition of latex foam rubber products. The object is immediate recognition of latex foam used in upholstered furniture, bedding, pillows and other furnishings. Participating companies will also carry replicas of the symbol used on the tag in their latex foam advertising.

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THE ONE DELAYED-ACTION CURE FOR BEST SPEED . . . SAFETY . . . ECONOMY

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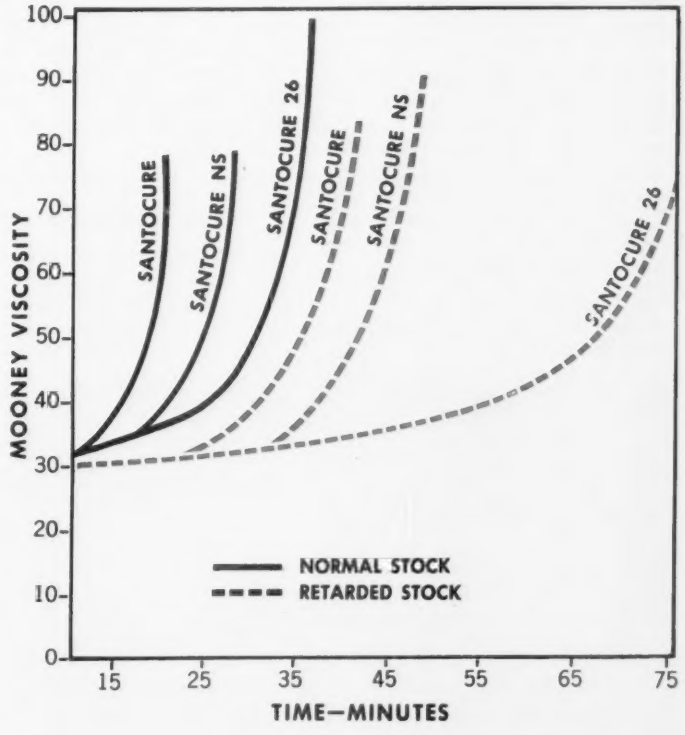

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Canadian News

► William F. McNurney has been named vice-president and general manager of General Tire and Rubber Co. of Canada Ltd., and will have his headquarters in Toronto. He succeeds R. H. Mallory, who has been given a new assignment. Mr. McNurney attended Rutgers University and joined General Tire in 1945 as a territory salesman. He has served as division manager at St. Louis, Mo., and headed the division at Boston, Mass. His most recent post was as regional manager of retail stores in the Northeastern United States.

► Henry A. Brundage, division manager of the comptroller's office of Goodyear International Corporation, has been appointed comptroller of the Goodyear Tire and Rubber Co. of Canada, Ltd., New Toronto, Canada. Mr. Brundage, who has been with Goodyear for 19 years, has been on temporary duty in India.

► The Toronto Sales Office of the Pigment & Chemical Co. Ltd. has been moved to a new company building at 162 Wicksteed Ave., Leaside. Administrative functions will still be carried out at the Montreal Head Office. The property on which the new building is located offers room for expansion of storage facilities.

► George R. Lawson has been elected vice-president and general manager and a director of Pennsalt Chemicals of Canada Ltd., Oakville, Ontario. Mr. Lawson, who has his headquarters in Philadelphia, Penna., is also general manager of Pennsalt's Chemical Specialties Division.

► Columbian Carbon Ltd. has purchased more than 20 acres of land from the city of Hamilton, Ontario, for $250,000 for the construction of a $5 million carbon black plant. The start of production there is slated for August 1961.

► Canadian Chemical Co., Ltd., an affiliate of Celanese Corp. of America, New York, N. Y., had net sales of $14.3 million and a net profit of $1.5 million for the six months ended June 30, 1960.

► Dickson Sheppard, technical superintendent of the Goodyear Los Angeles plant since 1955, has been named development manager of the Tire Division of Goodyear Tire & Rubber Co., in Akron, Ohio. He is succeeded by J. Kenneth Kennelly, formerly manager of technical services at the Los Angeles plant, whose former position will be filled by Russell L. Love.

► British Titan Products Ltd., has announced that it will build a new $15 million titanium oxide pigment plant at Tracy near Sorel, Que. Completion of the plant is slated for the summer of 1962. In the past the company has imported titanium oxide pigment from England.

Five Censured by FTC

► The Federal Trade Commission has issued an order barring price fixing and other anti-competitive activities by five manufacturers and marketers of products used in laying carpeting. Named in the order were: Roberts Manufacturing Co., City of Industry, Calif., and Roberts Corp., Rio Piedras, Puerto Rico, manufacturers of tackless carpet grippers, tools and accessories; Roberts Co., City of Industry, which markets the Roberts products; Ace Tackless Corp., Brooklyn, N.Y., and U.S. Tackless, Inc., New York, N.Y., makers of tackless carpet grippers under a patent license issued by Roberts. The FTC ruled that the three "closely integrated" Roberts companies engaged in a general conspiracy with licensees, including Ace and U.S. Tackless, to eliminate competition. A second charge, accusing the three Roberts companies of participating in a price-fixing conspiracy with the 146 Roberts distributors was upheld.

Goodrich Breaks Ground

► Company President J. W. Keener officiated as ground was broken recently for a new B. F. Goodrich Co. plant near New Haven, Ind. The company's Tire Division will operate the new plant, which is scheduled for completion in early 1961.

Donald E. O'Connell

Marbon Names O'Connell

► Marbon Chemical, Gary, Ind., has announced the appointment of Donald E. O'Connell as technical sales representative for Ohio, Indiana, Michigan, and Western Pennsylvania. His product lines will include Marbon 9200 and 1100T MV paint resins, 8000 series rubber resins, Marmix latices and Ty-Ply adhesives. A graduate of the University of Cincinnati, Mr. O'Connell has served as a sales representative for General Latex and Chemical Corporation, Cambridge, Mass., a research engineer for the Research Center of B. F. Goodrich Co., Akron, Ohio, and a sales coordinator for Reynolds Metals Co., Richmond, Va.

New Naugatuck Latex

► The Naugatuck Chemical Division of the U. S. Rubber Co., New York, N. Y., has developed a synthetic rubber latex to be used as a replacement for natural rubber in foam products. The new latex, Naugatex J-8174, is said by the company to have high uniformity, and to produce a foam equaling the resilience, compression modulus, and durability of natural foam. The new latex has a high solids content, produced by a method which enlarges the size of rubber particles to increase the rubber percentage, and maintains the free-flowing quality of the latex. The rubber particles are made to grow under controlled conditions, with each particle enclosed in a film of soap to keep it suspended in water solution and to prevent it, at the same time, from linking with other bits of rubber. The new process is called "chemical agglomeration."

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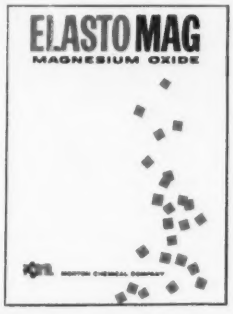

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Photo courtesy of Chicago Rawhide Company

Obituaries

Nathaniel S. Dodge Sr.

► Nathaniel S. Dodge, founder and president of the American Rubber Manufacturing Co., Oakland, Calif., died June 16 after a brief illness. Active in the rubber industry for 72 years, he was 86 years old. He started with the Mineralized Rubber Co., New York, N. Y., in 1888, four years later moving to Morgan & Wright Co., Chicago, Ill.

In 1894 he went to San Francisco, where he represented the New York Belting and Packing Co. and the Manhattan Rubber Co. He formed the Western Belting & Hose Co., with sales outlets in San Francisco and Los Angeles. In 1906 he founded the American Rubber Manufacturing Co., and was its president until the time of his death. Mr. Dodge designed and produced many rubber items utilized in early Western mining, and played a prominent part in the development of rubber products for the rock and gravel, contracting, lumber and canning industries. He is survived by three daughters and a son.

Glenn L. Smith

► Glenn L. Smith, special assistant to the president of the General Tire & Rubber Co., Akron, Ohio, died July 24 in Akron General Hospital after a two weeks' illness. He was 55 years old. A 1926 graduate of Notre Dame, Mr. Smith was employed by the First National Bank for 11 years. He joined General in 1935 as assistant to the manager of the General Tire Acceptance Corp. and was later assigned to the General Tire & Rubber Export Co. He became a special assistant in 1951. He is survived by his wife, a son by his first wife, his mother, and two brothers.

William A. Whittaker

► William A. Whittaker, an assistant to the president of Anaconda Wire and Cable Co. at the company's Hastings - on - Hudson, N. Y. office, died April 25 at New York Hospital after a long illness. He was 67 years old. Mr. Whittaker joined Anaconda in 1929 and became an assistant to the president in 1959. He is survived by his wife, a son, and two daughters.

Max Leitman

► Max Leitman, a director of the Vanderbilt Tire and Rubber Corp., New York, N. Y., died June 27 at St. Vincent's Hospital in Jacksonville, Fla., after a brief illness. He was 66 years old. Mr. Leitman was born in Russia and came to Florida as a child. His first venture in the rubber field was the founding of Tire Mart. He was a president of Tire Mart, and at the time of his death was chairman of the board of directors of the organization which is now a subsidiary of Vanderbilt and sells tires to owners of truck and bus fleets. Vanderbilt itself grew out of Tire Mart. He is survived by his wife; three sons, one the president, and the other two, vice-presidents of Vanderbilt; and a daughter.

John J. McIntyre

► John J. McIntyre, a founder of the Clevite Corp. of Cleveland, Ohio, died in University Hospital in Cleveland on July 3, following a brief illness. He was 81 years old. Mr. McIntyre attended Mount St. Joseph's College in Baltimore. After working as a sales executive for the American Tobacco Co., he helped found the Cleveland Graphite Bronze Co., a predecessor of Clevite. He retired as chairman of the board of Clevite in 1952, continuing as a director until 1957. He is survived by his wife and son.

Stewart Bolling

► Stewart Bolling, inventor and designer of machinery used in the rubber and plastics industries, died August 4 at his estate at Vanderpool, Va. He was president of Stewart Bolling & Co., Inc., Cleveland, Ohio, for a quarter of a century. The Government named Washington's Bolling Field for his family. Mr. Bolling is survived by his wife, a son, and a daughter.

Hayes R. Jenkins

► Hayes R. Jenkins, former secretary-treasurer of the General Tire and Rubber Co., Akron, Ohio, died August 6 of a heart ailment. He was 57 years old.

W. B. Weidenmeyer

► William B. Weidenmeyer, manager of general accounting for the Seiberling Rubber Co., Akron, Ohio, died in his sleep August 4 at his home. He had been with the company for 35 years and was 63 years old. Mr. Weidenmeyer attended Bucknell University at Lewisburg, Penna., and was a graduate of the Actual Business College in Akron. He was employed by Kelly-Springfield Tire Co., Cumberland, Md., the Mason Tire & Rubber Co., and the Portage Rubber Co., before joining Seiberling. He joined the company as a cost accountant, was manager of the Cost Department 15 years, and was named manager of general accounting in 1957. He is survived by his son, four grandchildren, and a sister.

Burt H. Yackee

► Burt H. Yackee, a chemist with Goodyear Tire & Rubber Co., Akron, Ohio, for 41 years, died April 7 in Gadsden, Ala. He was 67 years old. A 1916 graduate of the University of Akron, he was an assistant instructor in chemistry at the University in 1916 and 1917. He joined Goodyear in 1919 as a research chemist. In 1937 he was transferred to the company's Gadsen plant as chief chemist. At the time of his death he was section head in the Development Department, slated for retirement in May. He is survived by his wife, a son, and a daughter.

Laura An Lisk Firestone

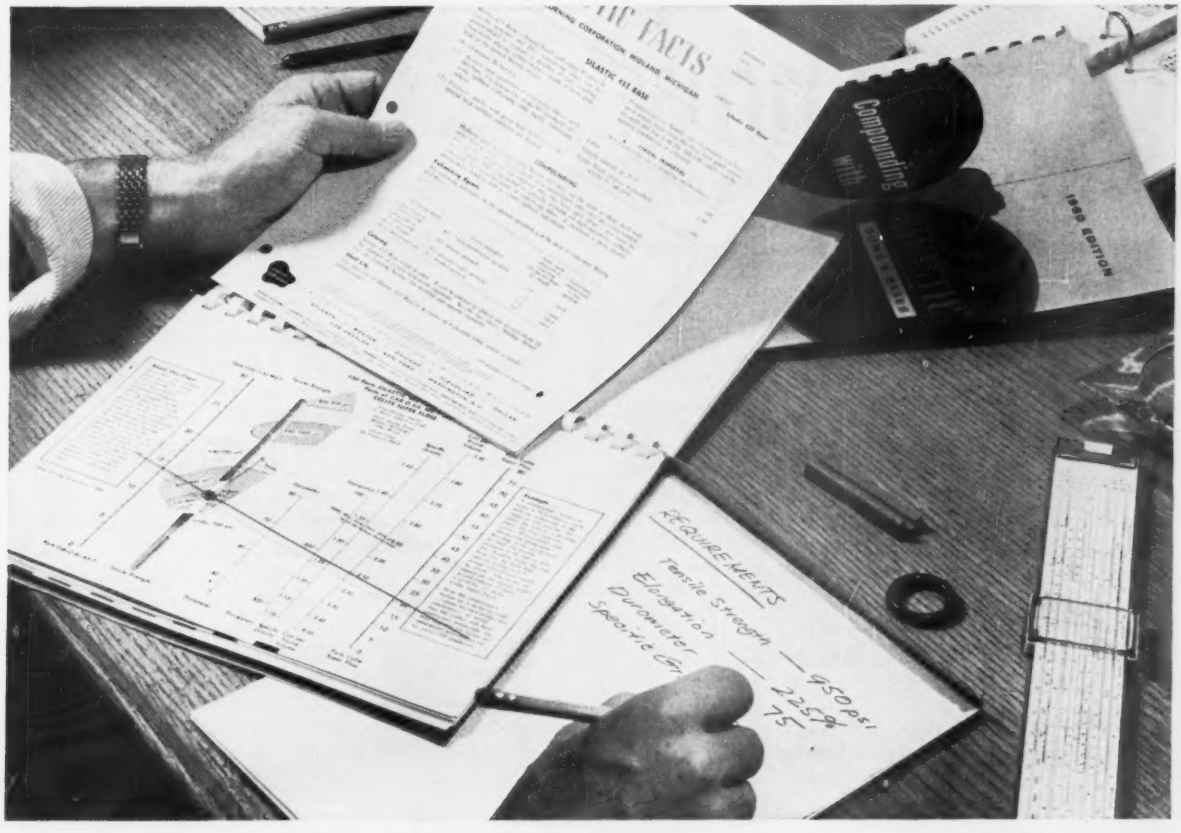
► Mrs. Laura An Lisk Firestone, wife of Raymond C. Firestone, president of the Firestone Tire and Rubber Co., Akron, Ohio, died July 3 in Akron General Hospital. She was 49 years old. She had married Mr. Firestone in 1934. A director of the National Garden Clubs of America, she was also active in civic causes. She is survived by her husband and two daughters.

Edmond W. Sanders

► Edmond W. Sanders, vice-president of Keystone Rubber Products Co., Buffalo, N. Y., for the past 10 years, died June 23 in East Aurora, N. Y. He was 56 years old. He had also been associated with Goodyear Tire & Rubber Co., Akron, Ohio, serving as manager of mechanical rubber goods sales. He is survived by his wife, a son, and a daughter.

SILICONE NEWS from Dow Corning

The Compleat Compounder



Silastic Bases Simplify Compounding, Expand Formulating Freedom

Rubber compounding is a complex problem with the many polymers available today. But you can avoid many of the problems involved in compounding silicone rubber by always starting with Silastic® gums and bases. When you buy Silastic brand compounding materials you're actually buying a compounding service. Look at what this includes:

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With one Silastic base material you can compound for a wide range of physical properties or applications, thus speeding production and improving the quality of your products. Stocks made from a Silastic base fabricate easily into custom parts to meet any customer's design. Another tangible benefit: you now inventory only one base instead of many finished stocks.

We invite you to investigate the advantages you accrue in compounding with Silastic materials, then make *your* own decision. Write for full information by addressing Dept. 7809.

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Overseas

Sofia—According to the Bulgarian Central Bureau of Statistics, output of the chemical and rubber industry increased 32.4 per cent during the first quarter of 1960 over the first quarter of last year.

Bucharest—Production of synthetic rubber started in Rumania this year, and under the country's Six-Year Plan for 1960-65 is expected to reach a figure of 50,000 tons a year in 1965. Over the same period tire production is expected to rise 350 per cent, from 312,000 tires in 1959, to 1.1 million by 1965.

Buenos Aires—Imperial Chemical Industries, Ltd., London, England, will build a $16 million polyethylene plastic plant near San Lorenzo, Argentina. The company also plans to build a $6.6 million industrial site and sulfuric acid plant there. Officials said the polyethylene plant will draw ethylene from local light petroleum distillates and will be operated by Duperil, Imperial Chemical's South American subsidiary.

Sydney—A nylon tire cord battle may be in the offing in Australia, between Allied Chemical Corp. and British Nylon Spinners. British Nylon has announced plans to invest about $14 million in expanded facilities for tire yarn at its Bayswater, Victoria, plant, doubling the amount already invested, and to reduce nylon yarn prices. Allied Chemical had already announced that it will, together with Polymer Corp. Ltd. of Australia, build a plant that, reportedly, will be capable of meeting all of Australia's current nylon tire cord requirements.

New Delhi—Synthetics & Chemicals, Ltd., a company recently formed by Firestone Tire & Rubber Co., and Kilechand Devchand & Co., Private, Ltd., a Bombay banking and industrial concern, have named Lummus Co., New York, N. Y., to build India's first synthetic rubber manufacturing plant. The $30 million project will be constructed near Bareilly, Uttar Pradesh. The contract calls for units to produce butadiene and styrene as well as a copolymer plant to manufacture synthetic rubber. Initial capacity is slated at 20,000 tons, with expansion to 30,000 tons possible.

Ibadan—The Nigerian contracting firm, T. A. Oni & Sons, Ltd., has expressed an interest in joining with a United States firm in establishing and operating a factory in Nigeria to produce camelback, foam rubber from native rubber and from polyethylene, and to retread tires. The proposed plant would be located near Lagos or Benin, in the Western region of Nigeria. Firms interested are invited to write to T. A. Oni, T. A. Oni & Sons, Ltd., P.O. Box 282, Ibadan, Nigeria.

STEP UP TILE QUALITY WITH CUMAR® RESIN

"CUMAR" Resin offers great advantages in tile compounding. Resistance to grease, water, alkali, caustic cleansers, soaps and bleaching agents, together with its compatibility with other compounding ingredients, makes "CUMAR" Resin desirable for clean, long-life flooring. And "CUMAR" Resin reduces batch stiffness, greatly improves ease of compounding and helps meet indentation specifications.

"CUMAR" Resins, available in a wide number of grades, are ideal processing aids, softeners and extenders. They provide successful and economic solutions to production problems in the manufacture of varnishes, floor tile, natural and synthetic rubber products, printing ink, adhesives and waterproofing materials.

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New Goods

Pin Core Fabricating Foam

► New "pin core" latex foam, said to be soft to the touch but firm for seating, has been developed by Goodyear Tire & Rubber Co., Akron, Ohio, for fabricating customized cushions. The new, all-purpose Airfoam, is a single-piece block of small core construction, molded from a blend of rubber latices. It is produced in 4 and 4⅞ inch

thicknesses, up to 80 inches in length, and is available in widths from 21 to 30 inches. The ability of the foam to resume its original shape after supporting weight for sustained periods is said to exceed the standards set by the cushioning industry.

Rubbermaid Silverware Drainer

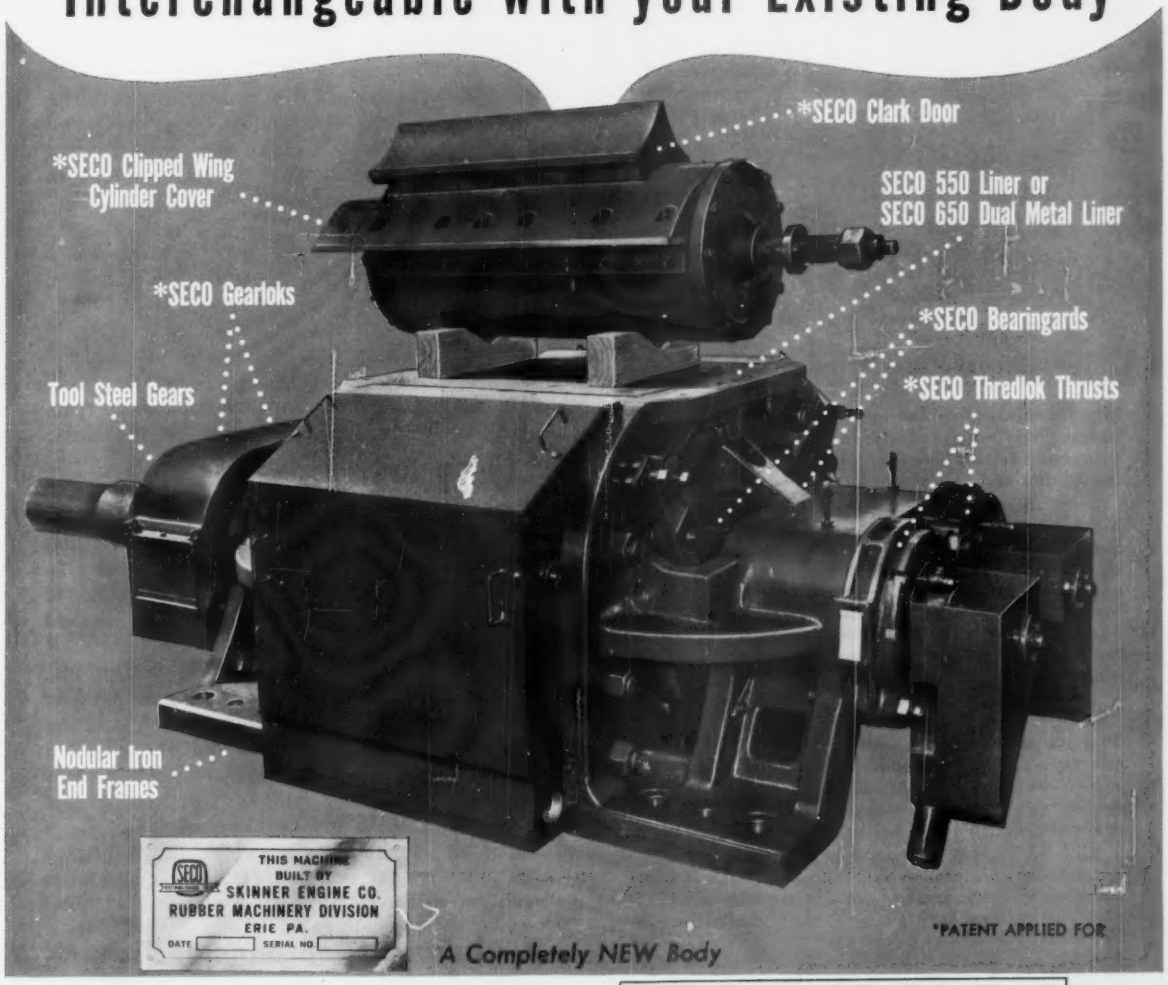
► A Silverware Drainer, manufactured by Rubbermaid Inc., Wooster, Ohio, holds silverware and kitchen utensils for air-drying. Four stand-up sections accommodate silverware, and a front tray is designed to hold cutlery, spatulas and ladles. The perforated base which permits fast, thorough drainage, is flat to allow the drainer to stand alone under a faucet for rinsing, or on a counter top for drying. A rolled edge attaches easily to all Rubbermaid Dish Drainers. The Silverware Drainer comes in white, yellow, pink, turquoise, and sandalwood.

Foam-Padded Ear Protectors

► Straightaway Ear Protectors, Model 372-20A, which weigh less than eight ounces and feature a foam-padded stainless steel headband, have been introduced by the David Clark Co., Worcester, Mass. The ear protectors are said to provide high attenuation not common to domes so slim and with such a low silhouette. The headband is easily adjusted to the head.

the New "SECO" MIXER BODY

Interchangeable with your Existing Body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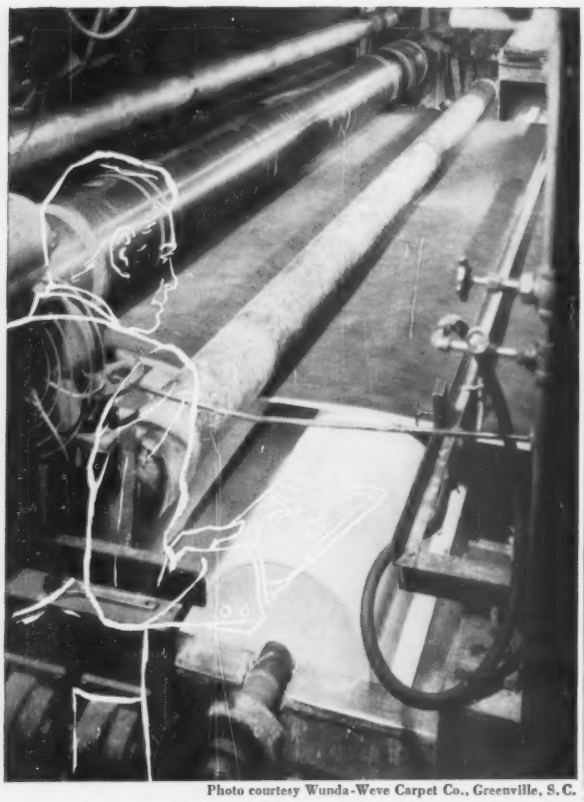

Photo courtesy Wunda-Weve Carpet Co., Greenville, S.C.

HOW THE SILICONES MAN HELPED... DEFOAM RUBBER LATEX AT LOW COST

Manufacturers of rubber latex rate SAG Silicone Antifoams "tops"—particularly in the sensitive, critical processing areas where control of foam may determine the quality and cost of products.

One latex compounder reports, "SAG Silicone is highly effective in reducing foam formed during manufacture and packaging of a variety of latex emulsions. By cutting down on the foam volume we save money and increase equipment efficiency." *A manufacturer of non-woven fabrics says,* "Small concentrations of SAG Silicone, between 50 and 100 parts silicone per million, prevent foam formation in the latex saturator, improving adhesion between latex backing and material."

Years of research went into development of SAG Antifoams to make them *Fight Foam Fast.* Less than 50 parts per million will often do the job. There are two types: SAG 470 Emulsion for aqueous systems; SAG 47 Fluid for non-aqueous systems. Just a few cents worth can eliminate thousands of cubic feet of costly, space-eating foam in rubber latex.

Both SAG products are shipped ready to use. Write for samples and information. Address Dept. IR-4906, Silicones Division, Union Carbide Corporation, 30 East 42nd Street, New York 17, N. Y. (*In Canada:* Bakelite Company, Division of Union Carbide Canada Limited, Toronto 7.)

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Removable Floor Tiling

► An interlocking rubber floor tile that can be installed by the homeowner, and removed for use in a new apartment or home, has been introduced by the Crown Rubber Co., Fremont, Ohio. Each tile interlocks with the next, in the same manner as a jigsaw puzzle except that the interlocks are uniform. Self-Lox, as the tile is called, is a do-it-yourself product which requires no mastic adhesive. It is reinforced with plastic for longer wear, and it can be used on any subfloor. Minute openings between the interlocking sections permit a minimum of water to seep through, and the same openings let air in to evaporate any water that is there.

Salmon-Transporting Rubber Pipe

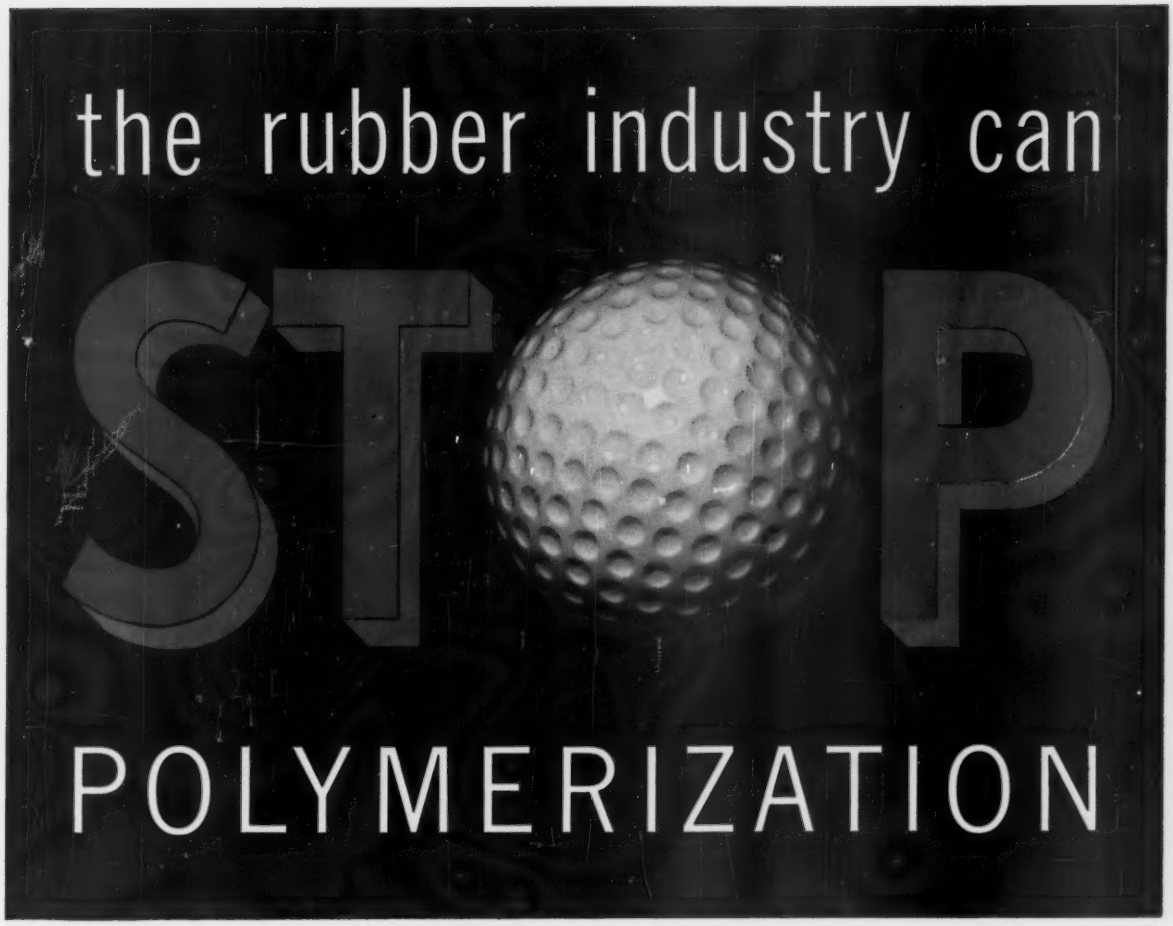
► Condor flexible rubber pipe manufactured by the Manhattan Rubber Division of Raybestos-Manhattan, Passaic, N.J., is serving as part of an extensive two-way conservation program on the Snake River between Idaho and Oregon. Salmon and steelhead fingerlings spawned upstream are being collected by an intricate system of traps, sorted by size, and delivered by pumping to waiting tank trucks half a mile away through 3,250 feet of the rubber pipe. The fish are diverted to the traps by a fine-mesh barrier net 120 feet deep, which prevents them from going over spillways or through the turbines of Brownlee Dam. The rubber pipe line runs from skimmers which attract the trapped fingerlings by artificial currents to a raised truck loading station on the Idaho shore.

Stadium Wall Padding

► Coverlight N and H, a nylon fabric coated with specially compounded neoprene on one side and Hypalon on the other, manufactured by the Vulcan Rubber Products Division of Reeves Brothers, Inc., New York, N.Y., has been used to cover the rubber padding on the wall of the Milwaukee Braves' stadium. The wall padding is designed to protect the outfielder by covering the concrete wall of the stadium. The Hypalon side of the covering is green, making it easier for the batter to see the ball as it approaches the plate. The fabric remains dimensionally stable under all weather conditions and, according to the manufacturer, will not rot or mildew and is resistant to deterioration from sun and weather.

Rubbermaid Rectangular Dishpan

► A new dishpan introduced by Rubbermaid Inc., Wooster, Ohio, features slotted hand grips to permit easy carrying and is made of durable, flexible, color-fast material. It fits all standard sink basins, and protects sink interiors. It has a capacity of 13 quarts and is available in red, white, yellow, pink, turquoise, and sandalwood.



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Hydroxylammonium Sulfate—$(NH_2OH)_2 \cdot H_2SO_4$—is an excellent non-discoloring short stopper for use with peroxide-catalyzed polymerizations. It is used in the production of butadiene-acrylonitrile rubber and other polymers.

Physical Properties	HYDROXYLAMMONIUM SULFATE
Formula	$(NH_2OH)_2 \cdot H_2SO_4$
Molecular Weight	164.14
Melting Point, °C	177*
pH of 0.1 M Aqueous Solution at 25°C	3.7
Solubility in 25°C, g/100 g solvent	
In Water	63.9
In 95% Ethanol	0.2
In Methanol	0.1

*Melts with decomposition.

"HS" destroys the peroxide polymerization catalyst as soon as polymerization has progressed to the desired stage. Products of decomposition are oxides of nitrogen which do not remain in the final product. "HS" is adaptable to both hot and cold polymerizations.

Some reports indicate improvement of rubber quality when "HS" is used. It has been found, too, that on a cost-efficiency basis, Hydroxylammonium Sulfate actually is more economical than some commonly used short stoppers.

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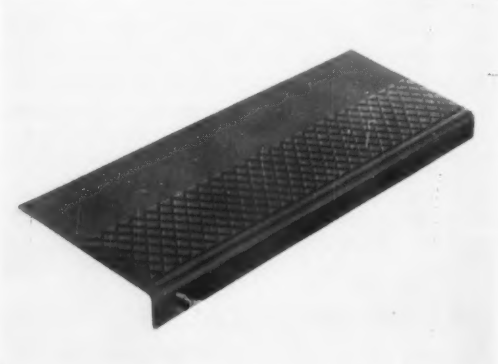
Traffic Lane Markers

► Traffic lane markers, made by Hoffran, Inc., Tampa, Fla., from Plioflex synthetic rubber produced by the Goodyear Tire & Rubber Co., Akron, Ohio, are being utilized on Bayshore Boulevard in Tampa. The markers will not bend wheel rims or damage tires when struck by cars and trucks. They give when hit, and do not chip,

crack, corrode or tear loose from the street, according to the manufacturer. The chrome yellow, mushroom-shaped markers are molded from Plioflex synthetic rubber toughened with Pliolite S-6E, a rubber reinforcing resin, and protected against weathering and discoloration by Wingstay S, a non-staining antioxidant. They can be fastened to a paved surface with a metal spike or expansion bolt with a recessed washer through the center, or can be attached with an epoxy resin adhesive. The first method is recommended for asphalt road surfaces, the second, for concrete.

Molded Rubber Stair Tread

► A molded rubber stair tread, said to be safety-designed with maximum resilience, slip-resistance, and noise reduction, is being marketed by the

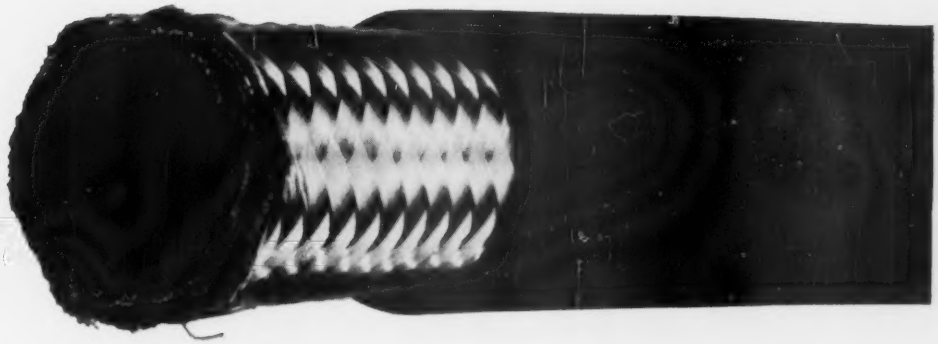


R. C. Musson Rubber Co., Akron, Ohio. The stair tread, No. 650, comes in red, green, grey, beige and black, and is described by the company as containing a high ratio of pure rubber to loading material.

Better corrosion protection . . .

Better adhesion with rubber . . .

NEW NS *ADPLY*-A* WIRE



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IN TIRE BEADS

National-Standard engineers have developed ADPLY-A wire for use in a variety of rubber products to provide twice the adhesion properties of present wire finishes plus as-good-as, or better, corrosion protection.

ADPLY-A is high-carbon steel wire coated first with zinc for good corrosion protection and then with brass for good adhesion, and is less sensitive to variations in rubber composition. This combination of double coating provides longer storage life, increased adhesion and corrosion protection for such applications as rubber hose reinforcing (where corrosion is a problem), and for aircraft tires. In fine sizes for high-pressure hose, ADPLY-A fulfills the need for a less-expensive wire than stainless steel, but with greater corrosion protection than liquor finish wire.

COMPARISON OF ADPLY-A WITH OTHER WIRE FINISHES

	ADPLY-A Adhesion	ADPLY-A Corrosion Protection
AP-1	Better	Same
BP Finish	Better	Better
Brass Finish	Same	Better
Liquor Finish	Better	Better

*Trademark

For complete information on new ADPLY-A wire from National-Standard, write to National-Standard Company, Niles, Michigan.

NS NATIONAL-STANDARD COMPANY

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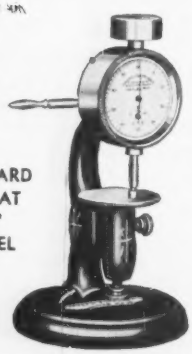
THICKNESS GAUGES FOR RUBBER



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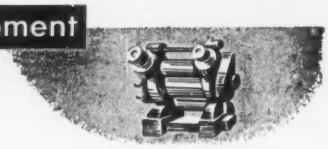
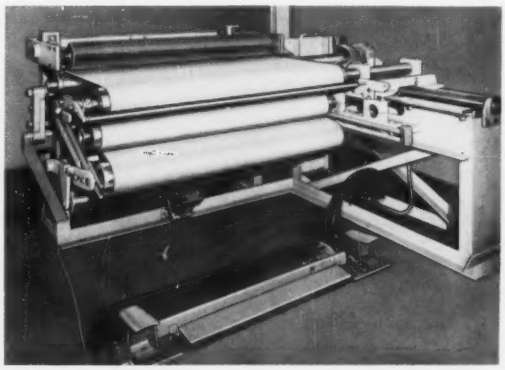
New Equipment



Tire Band Building Machine

► The Rapid-Ply band builder, manufactured by RJS Products Co., Inc., Akron, Ohio, is a belt type tire band building machine which enables rapid changing of the tire band size over a substantial range. It is said by the company to build bands 48 inches wide and from 56 to 107 inches in circumference with a minimum of set-up time.



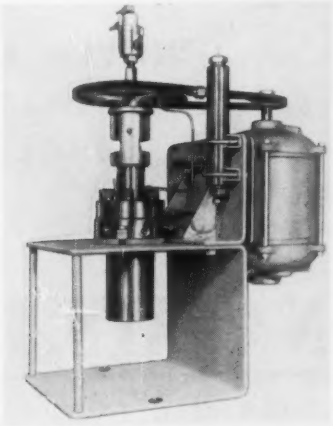
The band size for a given building belt is set by the turning of an adjusting crank, and the building belt is changed by the removal of one roll. A measuring scale is provided to assist in adjusting the machine to the proper band size. The entire range is covered by only two sizes of building belts. These are standard two-ply inextensible conveyor-type belts, with either metal or cemented splices. A two-ply hugger belt, also utilized, does not require changing except for replacement.

Dillon Push-Pull Gage

► This versatile new instrument, manufactured by W. C. Dillon & Co., 14620 Keswick St., Van Nuys, Calif., is said to do the work of two separate compression and tensile measuring devices. A split dial gives readings of compression loads and tensile loads. In addition, it can be hooked into a system to measure and control oscillating loads in compression and tensile. The gages are individually calibrated in capacities of 5-0-5; 12.5-0-12.5; 25-0-25; 50-0-50; 125-0-125; 500-0-500; 1250-0-1250; 2500-0-2500; 5000-0-5000; 12,500-0-12,500; and 25,000-0-25,000 pounds. Accuracy is guaranteed to within one per cent ± of full scale reading. All units, either split dial push-pull types or specific compression or tensile instruments, can be supplied with micro switches as optional features.

Bench-Scale Autoclave

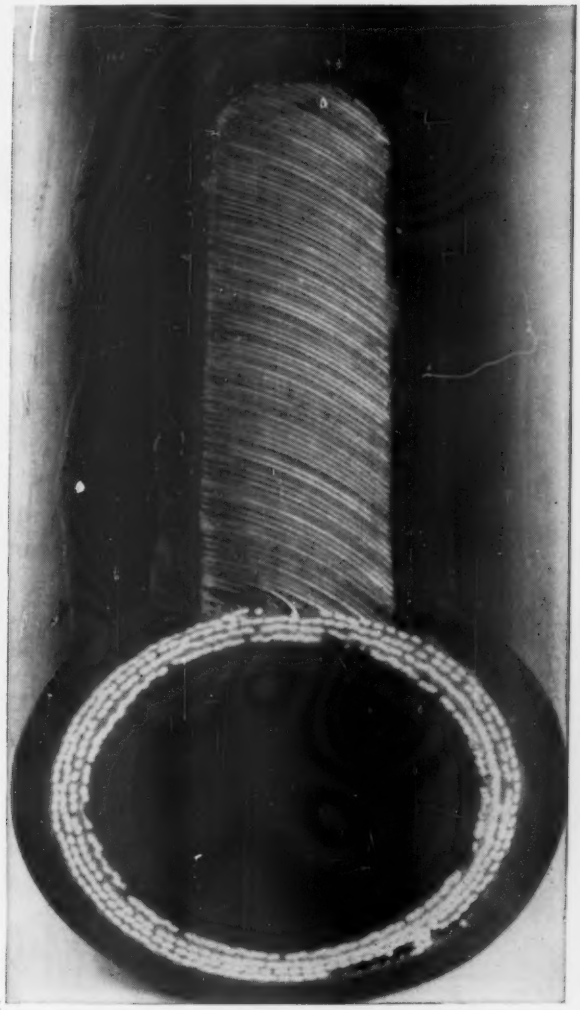
► Pressure Products, Inc., Hatboro, Penna., is offering an autoclave especially designed for bench-scale research. The new 300 ml, 5000 psig stirred reactor, together with stand and motor, is only 26 inches high and can be mounted on the floor, a bench or wall. A stirrer shaft, rotating



at speeds up to 1500 rpm, is water cooled and guaranteed for 500 hours operation. The reactor can be fitted with several types of stirrers: marine propeller, turbine, paddle or gas disperser. A novel feature is an intensifying lubrication cylinder adaptable to oil or water. A ½ h.p., 110/220 volt, single-phase, class I, group D motor is furnished with the unit.

Specimen Dimension Adjuster

► Scott Testers, Inc., 85 Blackstone St., Providence, R. I., has developed a new specimen dimension compensator which automatically adjusts test recordings for dimensional changes in specimen thickness, width, diameter or cross-section. Designed for use with Scott Model CRE Electronic Testers and Scott Accr-O-Meter conversion kits, the compensator is said to provide a fast simple, accurate means of obtaining tensile test recordings direct in psi, kgs/cm², grams/tex, or other selected bases. The operator merely turns standard 20-step dial control to the measured variable of the specimen before making the test. Maximum-minimum of specimen variables may be extended by adding one or more 20-step dials to the standard dial control. Any practical range may be furnished. The compensator attachment, together with push-button range selector on the tester control panel, provides multi-psi compensated ranges in ratios of 1; 0.5; 0.2; and 0/05. When not in use the entire unit swings back out of way, leaving tester in normal operating condition for readings in pounds or kilograms.



WIRE-IN-RUBBER

. . . problem solved

The ¾" high-pressure hose shown above has a 4-spiral wrap of high-tensile .012" liquor finish, high-carbon steel wire. This spiral wrap design is a new development by hose engineers that provides good fatigue qualities and high bursting strength for such critical applications as jet-aircraft hydraulic systems. The N-S special liquor finish on the wire provides better wire-to-rubber adhesion than old standard liquor finishes. The solution to this special wire-in-rubber problem is another National-Standard contribution to the rubber industry. Call National-Standard for help in solving your wire-in-rubber problems.

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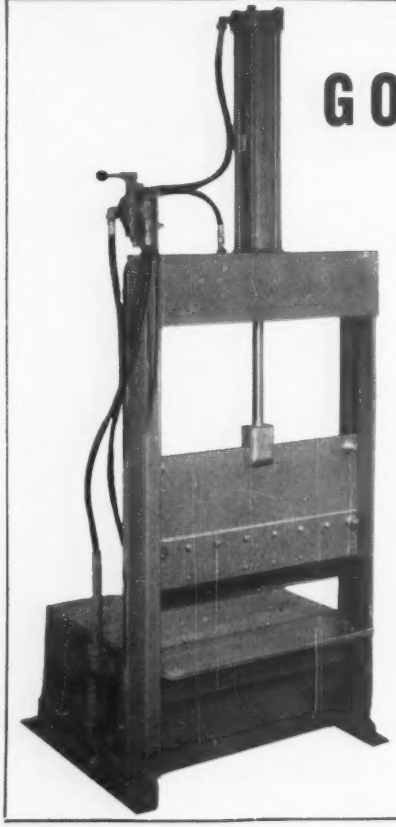
New, Self-Contained Hydraulic

GOODMAN BALE CUTTER



- New Self-Contained Model for Moderate Work Loads
- Larger Units for Higher Production
- Removable Hardened Toolsteel Blades
- Mild Steel Anvil for Cleaner Cutting
- Every Unit Pre-Tested under Power

Newest model Goodman Hydraulic Crude Rubber Bale Cutter is this 2 H.P. Cutter with self-contained power unit. It is ideal for use where up to 12 full bales per day are required. The 5 and 7½ H.P. models, with separate motor pump and oil reservoir, are designed for more capacity or continuous operation.

All Models now offer hardened toolsteel blades (removable for sharpening) and mild steel anvils for a cleaner cut with no adjustment required. Bale clearances are 30″ wide x 22″ high. Every unit is tested under power and shipped with hydraulic lines either connected or plainly tagged.

Write for Illustrated Bulletin and Prices!

Sales Representatives:
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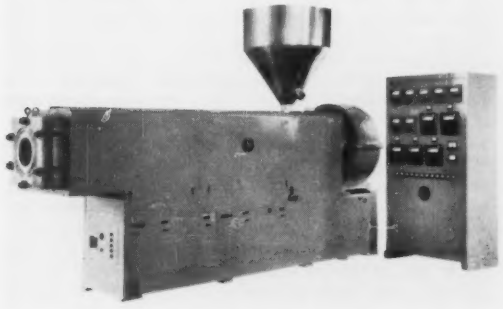
R. A. ROOSEVELT CO., La Mirada, Calif.

G. F. GOODMAN & SON

401 Richmond Street, Philadelphia 25, Pa.

Plastic Extruding Machines

► A new series of air-cooled plastic extruding machines with 6 and 8-inch diameter screws as standard equipment and 10 and 12-inch barrels made to special order, has been introduced by



Modern Plastic Machinery Corp., Clifton, N. J. The units are designed for heavy usage with a minimum of maintenance and have extra heavy-duty thrust bearings, forged steel barrels and precision ground screws. All four sizes are available in vented or non-vented design and in L/D ratios of 20:1 and 24:1. All units are supplied with resistance-band or cast-in heaters.

WILTRIM®

Model DF TRIMMER

Wills forty-two years experience brings you this outstanding successor to the famous earlier Models D, DE and DM trimmers.

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WIRE-IN-RUBBER

. . . problem solved

In the cross section of tire tread shown above, you see hundreds of tiny pieces of .006″ brass-plated, high-tensile, high-carbon steel wire. Cut to accurately measured lengths, the wire is molded into tire treads for added traction, better heat and static dissipation and longer life, for such applications as aircraft tires and other critical tire applications. The testing and manufacture of brass-plated, high-tensile wire with proper adhesion and strength was a National-Standard engineering contribution to the rubber industry. It is typical of the many National-Standard wire-in-rubber problem solutions. Call National-Standard for help in solving your wire-in-rubber problems.

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Niles, Michigan

WEATHERING and LIGHT AGING of RUBBER PRODUCTS

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WEATHER-OMETER®

A constant volume of air at a controlled temperature in the heavily insulated cabinet, maintains uniform predetermined specimen temperatures regardless of variations in room conditions.

Automatic control of humidities up to dew point is available as optional equipment.

All automatic controls are located on the front panel of the Weather-Ometer directly above the door of the test chamber.

Both horizontal and vertical testing is available. Shallow containers are used for semi-liquid materials and vertical panels for solid materials.

Source of radiation is two Atlas enclosed violet carbon arcs.

Complete technical information on the DMC Model and other Weather-Ometers is contained in the new Weather-Ometer catalog. Copy on request.

FADE-OMETER®

The Atlas Fade-Ometer has world-wide acceptance as the standard machine for testing the action of sunlight on materials.

A wide range of industrial products are tested daily in Atlas Fade-Ometers to determine the deterioration of materials due to the action of sunlight.

From 21 to 126 samples, depending on size, can be simultaneously exposed to the light of the Atlas Enclosed Carbon Arc. Temperature is controlled automatically and humidity is furnished by evaporation from a constant water reservoir. Operation of the Fade-Ometer is completely automatic, permitting the machine to be left in continuous 24-hour operation.

The Carbon Arc Lamp in the Fade-Ometer produces radiation at the sample similar to sunlight, both as to intensity and spectral distribution.

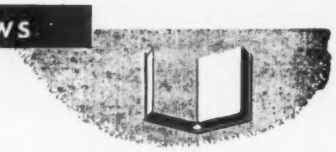
If your product is subject to deterioration by sunlight our engineers, with over a quarter of a century of experience in predetermining the fading of materials, can help you. *Catalog with technical information on request.*

ATLAS ELECTRIC DEVICES COMPANY

4114 N. Ravenswood Ave., Chicago 13, Ill.

Manufacturers of accelerated testing equipment for over a quarter of a century.

Reviews



The Rubber Manufacturing Industry. By A. T. Mathyoo. Published by Association of Rubber Manufacturers in India, 57-B Free School Street, Calcutta 16, India. 5½ x 8½ in. 187 pp. (No price listed.)

Not counting a couple of abortive starts, the rubber industry in India is little more than 25 years old. It comes as somewhat of a surprise, therefore, to find one of the most succinct treatments of rubber manufacturing materials and methods to originate in any country written by the secretary of the Association of Rubber Manufacturers in India, Mr. Mathyoo. It will no doubt be read mainly for the light it sheds on the investment and import potential of our "neutral ally," but it could serve equally well as an introductory text to a student of the rubber industry anywhere.

This is an especially auspicious time to familiarize oneself with business opportunities in one of the countries once officially called "backward," then "underdeveloped," now "developing." U. S. corporations, finding themselves unable to undersell foreign goods in many fields because of wage differentials, are shipping more and more capital abroad, saving further on shipping costs where relocation moves machines closer to sources of raw material. India offers one of the most suitable climates for such ventures, since it combines a rather loosely "planned economy" with the spirit of laissez faire inculcated by British training and entrepreneurs of earlier days.

Political neutralism has perhaps been made too much of a potential hazard in the case of a country traditionally tied to the West, becoming more anti-Communist with increasing pressure from Red China, and giving concrete evidence of its economic flexibility by allotting a greater share of its Third Five-Year Plan to private investment—$8.4 billion out of a total of $21.4 billion. With the Second Plan just finishing about 20 per cent short of its goals, the government's resort to greater tolerance rather than repressive measures can indeed be seen as an impressive display of political maturity.

Manufacturers and suppliers in the U. S. rubber sector have been a little hesitant about moving into this promising market with its tremendous consumer potential in tires alone once living standards are raised and good roads completed. True, Firestone is participating in a project to build India's first synthetic rubber plant near Bareilly, to have an initial production capacity of 20,000 tons a year. Then too, a Phillips Petroleum subsidiary has announced construction of a carbon black plant near Durgapur which should be turning out furnace blacks at an 11,000-ton annual rate starting the end of 1961. Another facility, 60 per cent owned by Union Carbide is due to go on stream in about six months, producing polyethylene, butyl alcohol, acetic acid and ethyl acetate.

Vital as they are, these beginnings are rather few and belated. According to the figures supplied by Mr. Mathyoo in his introductory chapters which trace indigenous developments and prospects: From 1939 to 1955 exports of rubber manufactured goods had outweighed imports by a margin hovering around 2 to 1. The favorable balance of trade was reversed sharply in 1957 under the pressure of rapid industrialization, swinging over about 1 to 3 in favor of imports. The big item was tires. Only the most ideal conditions will enable projected plants to satisfy an anticipated annual demand for 4 million tires and tubes domestically if predictions of 700,000 vehicles on the road by 1965 even come near the mark.

The section dealing with rubber plantations points out that those in India, concentrated under smallholder control in Kerala Province, average only about 270 lb. a year per acre, compared with more than 500 lb. yields in Malaya and Ceylon. No wonder Indian policy aims at modernization of planting and tapping. With the trade deficit worsening in the immediate future, converting the smallholder to modern plantation methods becomes of crucial government concern.

As emphasized above, the bulk of the text describes processing techniques and materials in admirable summary form. Illuminating as these chapters are per se, the clues they provide on opportunities for modernization and investment will probably prove the most highly prized feature of this landmark survey to U. S. readers.

•

Properties and Structure of Polymers. By Arthur V. Tobolsky. Published by John Wiley & Sons, Inc., 440 Park Ave. South, New York 16, N. Y. 6 x 9 in. 331 pp. $14.50.

Simplification is the keynote of this treatise on the mechanical behavior of polymers. Fortunately, the author, a distinguished Princeton professor and industry consultant who has more than 125 research papers to his credit, is well equipped to strike a happy medium between highly technical analysis and oversimplification. The result is a textbook not only logically organized around the most essential facets of a complex subject, but also tailor-made to the needs of graduate students and junior researchers. It sets out, as other manuals have, to discuss more or less familiar, basic concepts first, as a basis for a survey of the more novel and abstruse. If this text succeeds where others have faltered, the deciding factor must be the author's experience as a teacher and his direct involvement in viscoelastic research for nearly twenty years.

An explanation of molecular structure and dynamics serves as a springboard for discussions of laboratory work, in turn leading to generalizations on the physical properties of fibers, rubber, plastics and other polymers. The tempting byways of mathematical proofs and theories are avoided wherever possible. The sophisticated reader has not been shortchanged however, with one major chapter devoted to the complex models and concepts underlying linear viscosity. Another section describes the most recent approaches to equilibrium polymerization and copolymerization equilibrium in equally recondite terms. Finally, particularly useful functions and equations are defined in a series of ten technical appendices on such topics as configurational entropy of a gas, the expected square of the length of a hydrocarbon-type chain, and maximum relaxation times.

The utility of this tersely written, information-packed book is enhanced by numerous drawings, graphs, tables and photographs. Specialists in the field of rubber technology will find extensive discussions of rubbery flow, rubbery plateau and the equation of state for rubbers. The last-mentioned refers to one of the most original presentations in the book: centered around an exposition of the kinetic theory of rubber elasticity derived from Professor Tobolsky's earliest research, it is prefaced by a general review of modulus and followed by an appendix based on the author's latest work on the statistical thermodynamic treatment of polymer chains. The comprehensive nature of literature as well as laboratory research distilled here is evidenced by the range of citations from Einstein's earlier papers to recent Soviet journals.

The appearance of an outstanding volume by a noted authority in the field of polymer physico-chemistry is an event of great importance to rubber research. It is an especially welcome circumstance when it combines the highest level of erudition, selectivity and lucidity with a fundamentally pragmatic outlook.

WIRE-IN-RUBBER

. . . problem solved

The polyethylene bead wire package shown above is another new development from National-Standard that permits more extended storage of bead wire without danger of rust or corrosion.

Extensive testing of the new package over many months in highly humid environmental chambers, without any evidence of wire corrosion, proved the new package superiority over old-style wrappers . . . means tire manufacturers can store bead wire for months without fear of damage.

The solution to this special wire-in-rubber problem is another National-Standard contribution to the rubber industry. Call National-Standard for help in solving your wire-in-rubber problems.

NS NATIONAL-STANDARD COMPANY

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Niles, Michigan

THE ORIGINAL...

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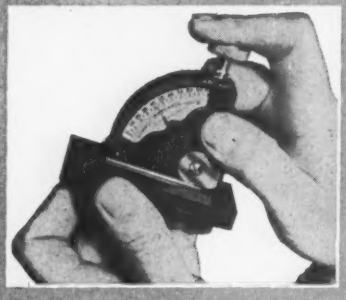

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Also Available in:

ROUND DIAL — MAXIMUM READING — for measuring cold flow or creep.

ROUND DIAL — CONSTANT LOAD — *(with dead weight attachment)* to eliminate variations in readings due to variable pressures in manual application.

The Shore Durometer is available in various models for testing the entire range of rubber hardness and is furnished complete with standard spring block and carrying case.

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CUTTING MACHINE

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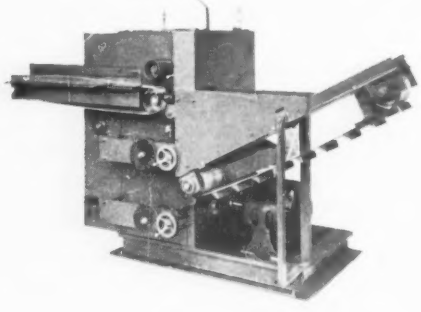
Where High Production is Required



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Lengths: 1/4" to 6"
Up to 2000 cuts per Min.
Continuous feed direct from Extruder

UTILITY MANUFACTURING COMPANY

Cudahy, Wisconsin

Write For Complete Information

BOOKLETS, CATALOGS, etc.

Compounding With Silastic. Dow Corning Corp., Midland, Mich. 8½ x 11 in. 56 pp.

This comprehensive manual is designed to give a maximum amount of know-how about Silastic silicone rubber. It reveals how to choose compounding materials to fit specific applications; how to formulate these materials; and how to handle these materials for production speed and efficiency. The booklet consists of a series of articles, each dealing with a specific aspect of compounding, such as: advantages and problems of compounding; Silastic compounding materials; fillers for silicone rubber; two-filler combinations; filler-base and filler-gum combinations; shelf-aging of unvulcanized compounds; vulcanizing agents; additives; and equipment and procedures. The final section of the manual contains the latest Silastic prices.

•

Ucon Fluids and Lubricants. Union Carbide Chemicals Co., 30 East 42nd St., New York 17, N. Y. 8½ x 11 in. 52 pp.

This booklet describes the properties and uses of Ucon polyalkylene glycol fluids and lubricants. It contains comprehensive data on the 32 types of Ucon synthetic fluids and lubricants available from Carbide Chemicals. Included are physical properties, physiological properties, physical and chemical analytical methods, storage and handling instructions, and a special section on the selection of the proper Ucon fluid or lubricant for any given application.

•

Polysulfide Crude Rubber. (Bulletin CS-1.) Thiokol Chemical Corp., 780 N. Clinton Ave., Trenton, N. J. 8½ x 11 in. 8 pp.

Solvent and oil resistant varieties of polysulfide crude rubbers, according to this pamphlet, have been endowed with improved resistance to compression set by certain calcium oxide activators. Graphs and charts summarize laboratory studies of activated compounds for both zinc peroxide and GMF curing systems. Additional data indicates the effect of cure time and temperature on the compression set characteristics of typical compounds.

•

Extra Heavy Duty High Speed Disperser. (#8-D). Charles Ross & Son Co., 148-156 Classon Ave., Brooklyn, N. Y. 8½ x 12 in. 2 pp.

This brochure covers the company's line of high speed, multiple action dispersers which are used to mix, dissolve, emulsify, deagglomerate and disperse all types of thin or heavy paste materials. The booklet describes the design and functioning of the millhead. Laboratory and production size equipment and stationary tank type mixers are included. In addition, the literature features a complete specifications chart.

•

Parbak Back-up Rings. (Catalog No. 5482). Parker Seal Co., 10567 Jefferson Blvd., Culver City, Calif. 8½ x 11 in. 8 pp.

The catalog describes Parbak back-up rings, and tells how to increase O-ring life; seal higher pressures; and reduce costs. To assist engineers in designing and specifying Parbaks, the booklet contains sections on design aids; ring sizes and dimensions; and compound information.

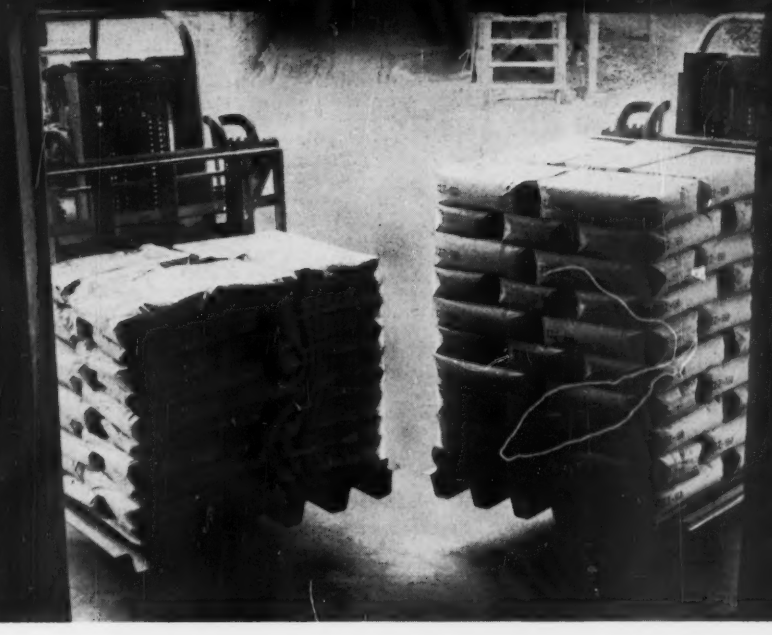
•

Company Brochure and Catalog. Ernest F. Fullam, Inc., P.O. Box 444, Schenectady, N. Y. 8½ x 11 in. 16 pp.

This latest Fullam brochure stresses company research services, with emphasis on such laboratory facilities as electron, x-ray and light microscopy, electron and x-ray diffraction, x-ray spectrography, and microprobe. General layout of facilities and pictures of equipment are included.

Now you can greatly increase warehouse space at no increase in cost with...

AZODOX high apparent density zinc oxides



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AZODOX stores in much less space than other zinc oxides. That's because you get many more pounds of AZODOX per cubic foot of pigment—up to 62 lbs. per cubic foot! Save valuable space for other purposes with every ton of AZODOX you buy.

In the manufacture of AZODOX, an exclusive process removes excess, space-wasting air from between individual particles of zinc oxide. Actual pigment density and every other desirable property remain unchanged. High apparent density AZODOX flows freely yet dusts less, incorporates fast and disperses thoroughly.

AZODOX is available in the following grades at no additional cost over conventional zinc oxides:

	Bulk Density lbs./cu. ft.	Rate of Activation	Reinforcement Properties
AZODOX-44 (Conventional)	60	Medium	High
AZODOX-55 (Conventional)	60	Fast	High
AZODOX-55-TT (Surface Treated)	62	Fast	High
AZODOX-550 (Conventional)	58	Medium	High

For technical data, fill in and mail this coupon.

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- ☐ AZODOX-44
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MARKET REPORTS

TRENDS
NEWS
PRICES

Natural Rubber

The price of natural rubber on the New York Commodity Exchange has moved in a range of 275 points since our last report (August 1), high for the period being 38.25c reached on August 1 and 2, and low being 35.50c reached on August 22 and again on August 30. The average price of spot rubber for the month of August was 36.69c based on 23 trading days. This compares with an average of 40.90c in the previous month.

A lack of aggressive buying interest continues to feature the futures market, according to Merrill Lynch, Pierce, Fenner & Smith. The short side of nearer positions still is held largely by dealers, with only light covering of them as prices declined further.

World-wide offtake of physicals is still generally low despite recent price cuts. Seasonal factors partly explain this situation. The extent of buying following Labor Day may be a guide as to what the immediate future has in store.

Singapore's prices have been depressed by statistics from the United States, while Malayan inventories of rubber have increased. In Indonesia, the export duty (over 15 per cent of f.o.b. price) was rescinded, but trade sources indicate that this removal has failed to have any real effect upon the market.

Key to the Problem

The key to natural rubber prices apparently lies with the synthetic rubber industry. The time is fast approaching when ample synthetic rubber supplies all over the world will give rubber consumers a free choice between natural and synthetic. Under these conditions, it will be very difficult for natural to maintain even a small premium over synthetic.

Barron's points out that another price factor has been the release of natural rubber from government stockpiles. The growth of synthetic production has largely obsolesced the stockpiles.

The General Services Administration plan for the sale of stockpiled rubber calls for unlimited sales when the price is above 36c a pound. Sales will be suspended when prices drop below 30c a pound. There is a likelihood that this operation may become academic in a few years as new synthetic plants go into full production.

Rubber earmarked for sales by GSA covers an eight-year period. Obviously, in eight years different factors will pertain, not only for natural rubber but for synthetic. The stockpile continues to remain a thorny issue, offering comfort to neither government nor industry.

Such long-term developments are bound to have an effect upon the day-to-day operations of the market. As in the political area, uncertainties about the future are creating new and major problems for natural rubber producers and consumers.

NEW YORK, SEPTEMBER 1, 1960

Price Data

Closing Rubber Prices on New York Commodity Exchange

FROM AUGUST 1 TO AUGUST 31

Aug.	Spot	Sept.	Nov.	Jan.	Sales
1	38.25	37.38	36.23	35.60	29
2	38.25	37.71	36.45	35.70	50
3	37.63	37.15	36.10	35.40	8
4	37.50	37.00	36.00	35.35	17
5	37.25	36.75	35.85	35.30	18
6	....	....	....	....	..
7	....	....	....	....	..
8	37.50	37.40	36.10	35.60	19
9	37.25	37.05	35.95	35.45	17
10	37.25	37.00	35.75	35.20	4
11	36.75	36.55	35.30	34.90	56
12	37.00	36.85	35.50	35.00	3
13	....	....	....	....	..
14	....	....	....	....	..
15	36.75	36.65	35.20	34.65	29
16	36.50	36.45	35.10	34.60	45
17	36.25	35.85	34.12	33.60	57
18	36.00	36.30	33.80	33.15	120
19	36.25	36.55	33.80	33.05	59
20	....	....	....	....	..
21	....	....	....	....	..
22	35.50	36.30	33.55	32.85	93
23	36.00	36.55	33.75	32.90	49
24	36.00	36.50	33.85	32.95	47
25	37.00	36.50	34.00	33.10	46
26	35.75	36.10	33.75	32.75	91
27	....	....	....	....	..
28	....	....	....	....	..
29	35.75	35.55	33.85	32.99	30
30	35.50	35.30	34.00	33.00	24
31	36.00	35.95	34.40	33.40	50

Outside Market

No. 1 Ribbed Smoked Sheets:	
Spot	.36
Sept.	.35¼
Oct.	.34⅜
Thin Latex Crepe:	
Spot	.37½
Thin Brown Crepe, No. 2	.29¾
Flat Bark Crepe	.23

London Market
(Standard Smoked Sheets)

Oct.	33.24 — 33.38
Jan.-Mar.	32.80 — 32.94

Singapore Market
(Standard Smoked Sheets)

Oct.	31.88 — 31.96

Middling Upland Quotations

	July 29	August 31		
	Close	High	Low	Close
Oct.	31.09	31.04	31.02	31.02
Dec.	31.28	31.27	31.27	31.27
Mar.	31.60	31.83	31.83	31.80

Notes & Quotes

Research in natural rubber must be increased if the tree-grown material is to continue side-by-side with synthetic rubber as an important industrial commodity, according to Dr. W. E. Cake, vice-president and coordinator of research, U.S. Rubber Co. Dr. Cake points out that for the first time world capacity for the production of synthetic rubber is greater than the production capacity for natural rubber. He also notes that the newer synthetic types are posing additional problems to natural rubber.

Synthetic Rubber

In the first seven months of this year, 876,014 long tons of all types of reclaimed rubber were produced in the United States compared with the 761,638 long tons produced in the first seven months of the previous year.

Consumption of all types of synthetic rubber in the first seven months of this year totaled 644,142 long tons, or 68.19 per cent of al the new rubber consumed in 1960. In the first seven months of 1959, 612,674 long tons of synthetic rubber were consumed and this represented 65.35 per cent of all the new rubber consumed up to that point.

While consumption of synthetic so far in 1960 is not too much ahead of the comparable period of the preceding year, it is interesting to note that the synthetic rubber segment has increased its percentage of the total new rubber market by almost 3 per cent.

New Trend in Offing?

Analysts at Merrill Lynch, Pierce, Fenner & Smith observe that it is a litle difficult to determine which was more disconcerting about the July domestic statistics: total consumption or the synthetic ratio to total new rubber use. Total new rubber used at 115,000 long tons was the smallest for any month since May, 1959. Natural alone was only 35,000 long tons against 42,600 in June and 47,600 in July, 1959.

Meanwhile, synthetic continued to take markets away from natural. It represented 69.51 per cent of the total new rubber consumed in July, and this represented a new all-time high. This is significant because for years a 65 to 35 per cent ratio has been almost an historical figure.

Some trade observers believe that for the full calendar year, the loss of domestic consumption of natural against 1959 may approximate 45,000 long tons. For the first half of 1960, the loss amounted to 15,000 long tons and with July included came to nearly 25,000 long tons. Thus, some 20,000 long tons of lag may still be ahead.

Another pressure toward synthetic, although mostly psychological, has come from Goodrich-Gulf which has inaugurated an active program for granting licenses to manufacture synthetic-natural rubber (polyisoprene) in the United States and Canada. In the opinion of some in the trade, this is a product which could eventually replace, either partially or in whole, natural rubber. It should be noted, however, that volume production of this type of synthetic rubber is still some years in the future.

For the short term, however, significant reductions in the price of natural rubber may alter natural-synthetic consumption ratios. Over the long pull, it would seem that natural it not in the most favored position.

PANAREZ Resins

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Reduced processing costs

Equal or better quality finished product

Do you work with SBR, neoprene or natural rubber? Do you produce: shoe sole stocks, mechanical goods, rubber tile, wire insulation, garden hose, belting, gasketing, footwear, automotive sponge rubber or cements?

If the answer is yes, then this is what PANAREZ Hydrocarbon Resins can do for you: They lower Mooney Viscosity, permitting: (1) easier processing with lower power requirements, (2) shorter processing cycles. They improve flex-crack resistance while retaining the advantages of other higher priced resins. PANAREZ Resins can also give such benefits as: easy milling, improved color stability, excellent mold flow, easy filler dispersion and good tear strength. Electrical insulation gets the benefit, with PANAREZ Resins, of improvement in extrusion characteristics without sacrificing electrical properties.

Get more facts. Ask your Amoco Chemicals representative for Bulletin F-2.

AMOCO CHEMICALS

AMOCO CHEMICALS CORPORATION
910 South Michigan Avenue
Chicago 80, Illinois

Dry Rubber

(per pound carload)

Butadiene-Acrylonitrile Types

Butaprene NF	.4900
Butaprene NH	.6500
Butaprene NL	.5000
Butaprene NXM	.5800
Chemigum N1NS	.6400
Chemigum N3NS and N5	.5800
Chemigum N6	.5000
Chemigum N6B	.5000
Chemigum N7	.5000
Chemigum N8	.5000
Chemigum N600	.5000
Herecol N-33	.6800
Hycar 1001 and 1041	.5800
Hycar 1002	.5000
Hycar 1014	.6000
Hycar 1042 and 1043	.5000
Hycar 1051	.5800
Hycar 1052	.5000
Hycar 1053	.5000
Hycar 1072	.6400
Hycar 1203	.4600
Hycar 1312	.5000
Hycar 1411	.6200
Hycar 1432	.5900
Hycar 1441	.6200
Paracril AJ	.4850
Paracril B and BJ	.5000
Paracril BLT and BJLT	.5000
Paracril C and CLT	.5800
Paracril CV	.6300
Paracril D	.6500
Paracril 18-80	.6000
Paracril OZO	.4600
Polysar Krynac 800	.5000
Polysar Krynac 801	.5800
Polysar Krynac 802	.5000
Polysar Krynac 803	.5000

Butadiene-Styrene Types

Ameripol 1000	.2410
Ameripol 1001	.2410
Ameripol 1002	.2435
Ameripol 1006	.2410
Ameripol 1006 (crumb)	.2475
Ameripol 1007	.2410
Ameripol 1009	.2475
Ameripol 1009 (crumb)	.2590
Ameripol 1011	.2475
Ameripol 1012	.2425
Ameripol 1012 (crumb)	.2490
Ameripol 1013	.2410
Ameripol 1013 (crumb)	.2615
Ameripol 1500 and 1501	.2410
Ameripol 1502	.2410
Ameripol 1605	.1900
Ameripol 1703	.2060
Ameripol 1705	.2035
Ameripol 1707	.1910
Ameripol 1708	.1910
Ameripol 1710	.1885
Ameripol 1712	.1885
Ameripol 1805	.1550
Ameripol 1808	.1480
Ameripol 1809	.1545
Ameripol 1810	.1400
Ameripol 4600	.2410
Ameripol 4650	.1820
Ameripol 4651	.1770
Ameripol 4652	.1425
Ameripol 4654	.1870
Ameripol 4655	.1820
Ameripol 4659	.1820
Ameripol 4660	.1870
Ameripol 4700	.1750
Ameripol 4752	.1600
Ameripol 4760	.1576
Ameripol 4759	.1600
Ameripol 4761	.1710
ASRC 1000	.2410
ASRC 1001 and 1004	.2410
ASRC 1006	.2410
ASRC 1009	.2475
ASRC 1018	.2700
ASRC 1019	.2650
ASRC 1500	.2410
ASRC 1502	.2410
ASRC 1503	.2625
ASRC 1703	.2060
ASRC 1708	.1910
ASRC 1712	.1885
ASRC 1713	.1750
TSRC 3105 and 3106	.2410
ASRC 3110	.2600
Baytown 1600	.1930
Baytown 1601	.1930
Baytown 1602	.1930
Baytown 1801	.1760
Baytown 1803	.1740
C-102 (Shell)	.2300
Carbomix 3750	.1820
Carbomix 3751	.1545
Carbomix 3752	.1845
Carbomix 3753	.1640
Carbomix 3756	.1569
Carbomix 3757	.1480
Carbomix 3758	.1545
Carbomix 3760	.1496
CB-102 (Shell)	.1850
Copo 1006	.2410
Copo 1500	.2410
Copo 1502	.2410
Copo 1505-NS	.2610
Copo 1507	.2410
Copo 1712	.1885
Copo 1713	.1750
Copo 1714	.1725
Copo 1773	.2060
Copo 1778	.1910
Copo 2000	.2775
Copo 3700	.1725
Copo 3701	.1750
Copo 3900	.2310
FR-S 146	.2410
FR-S 158	.3000
FR-S 173	.2060
FR-S 178	.1910
FR-S 181 and 182	.2410
FR-S 184	.1885
FR-S 1000	.2410
FR-S 1001	.1410
FR-S 1004 and 1006	.2410
FR-S 1007	.2410
FR-S 1009	.2475
FR-S 1010	.2600
FR-S 1012	.2425
FR-S 1013	.2410
FR-S 1014	.2810
FR-S 1500 and 1502	.2410
FR-S 1703	.2060
FR-S 1710 and 1712	.1885
Gentro 1500	.2410
Gentro 1712	.1885
Gentro-Jet 9152	.2080
Gentro-Jet 9153	.1820
Gentro-Jet 9154	.1845
Gentro-Jet 9250	.1580
Gentro-Jet 9251	.1640
Gentro-Jet 9252	.1670
Gentro-Jet 9275	.1500
Naugapol 1016	.2650
Naugapol 1018	.2700
Naugapol 1019	.2650
Naugapol 1022	.2950
Naugapol 1023	.3150
Naugapol 1503	.2625
Naugapol 1504	.0330
Naugapol 6003	.2700
Naugapol 6100	.3100
OB-102 (Shell)	.1825
OB-104 (Shell)	.1475
OB-106 (Shell)	.1510
OB-110 (Shell)	.1410
OB-111 (Shell)	.1540
OB-113C (Shell)	.1750
OB-114C (Shell)	.1420
OB-116 (Shell)	.1810
Philprene 1000	.2410
Philprene 1001	.2410
Philprene 1006	.2410
Philprene 1009	.2475
Philprene 1018	.2700
Philprene 1019	.2650
Philprene 1500 and 1502	.2410
Philprene 1503	.2625
Philprene 1601	.1930
Philprene 1603	.1960
Philprene 1605	.1900
Philprene 1606	.1820
Philprene 1609	.2080
Philprene 1703	.2060
Philprene 1708	.1910
Philprene 1712	.1885
Philprene 1803	.1740
Philprene 1805	.1550
Philprene 1808	.1480
Plioflex 1006	.2410
Plioflex 1500C	.2410
Plioflex 1502	.2410
Plioflex 1507	.2410
Plioflex 1508	.2410
Plioflex 1510	.2410
Plioflex 1710C and 1712C	.1885
Plioflex 1713	.1750
Plioflex 1714C	.1725
Plioflex 1773	.2060
Plioflex 1778	.1910
Polysar Kryflex 200	.2510
Polysar Krylene	.2410
Polysar Krylene NS	.2410
Polysar Krynol 651	.1885
Polysar Krynol 652	.1910
Polysar S-630	.2410
Polysar S-X 371	.2550
Polysar SS-250	.2875
S-1000	.2300
S-1002	.2325
S-1006	.2300
S-1009	.2400
S-1011	.2325
S-1013	.2300
S-1500	.2300
S-1502	.2300
S-1509	.2300
S-1600	.1825
S-1602	.1825
S-1604	.1825
S-1605	.1800
S-1606	.1750
S-1607	.1750
S-1703	.1950
S-1707	.1800
S-1709	.1775
S-1710	.1775
S-1712	.1775
S-1778	.1800
S-1800	.1475
S-1802	.1410
S-1803	.1650
S-1804	.1750
S-1806	.1510
S-1807	.1540
S-1808	.1420
S-7652	.1875
S-7701	.1850
SP-103 (Shell)	.2900
Synpol 1000 and 1001	.2410
Synpol 1002	.4435
Synpol 1006	.2410
Synpol 1007	.2410
Synpol 1009	.2475
Synpol 1012	.2425
Synpol 1013	.2410
Synpol 1061	.2410
Synpol 1500	.2410
Synpol 1502	.2410
Synpol 1551	.2410
Synpol 1703	.2060
Synpol 1707	.1910
Synpol 1708	.1910
Synpol 1712	.1885
Synpol 8103	.2401
Synpol 8151	.1820
Synpol 8152	.1860
Synpol 8200	.1910
Synpol 8201	.1750
Synpol 8202	.1725
Synpol 8208	.1750
Synpol 8255	.1480
Synpol 8253	.1584
Synpol 8254	.1545
Synpol 8266	.1598
Synpol 8267	.1640

Butyl Rubbers

Enjay Butyl 035 and 150	.2300
Enjay Butyl 165 NS	.2400
Enjay Butyl 215	.2300
Enjay Butyl 217	.2300
Enjay Butyl 218	.2300
Enjay Butyl 268 NS	.2400
Enjay Butyl 325	.2300
Enjay Butyl 365 NS	.2400
Polysar Butyl 100	.2450
Polysar Butyl 101	.2775
Polysar Butyl 200 and 300	.2450
Polysar Butyl 301	.2550
Polysar Butyl 400	.2450

Chlorosulfonated Polyethylene

Hypalon 20	.4700
Hypalon 30	.6000
Hypalon 40	.5000

Fluoroelastomers

Kel-F Fluorel	$15.00
Kel-F 3700 and 5500	$16.00
Vitron A and A-HV	$10.00
Viton B	$13.00

Neoprene

	(prices l.c.l.)
Neoprene Types AC and CG	.5500
Neoprene Type AD	.5500
Neoprene Type FB	.6500
Neoprene Type GN	.4100
Neoprene Type GN-A	.4100
Neoprene Type GRT	.4200
Neoprene Type KNR	.7500
Neoprene Type S	.4200
Neoprene Type W	.3900
Neoprene Type WB	.4100
Neoprene Type WHV	.3900
Neoprene Type WRT	.4500
Neoprene Type WX	.4100

SYNTHETIC RUBBER POLYMERS

Polysulfide Rubbers

	(prices l.c.l.)
Thiokol Type A	.5000 [3]
Thiokol Type FA	.6900 [3]
Thiokol Type ST	1.2500 [3]

Silicone Rubbers*

	(prices l.c.l.)
GE (compounded)	2.50 [3]
GE Silicone Gum (not compounded)	4.00 [3]
Silastic (compounded)	2.50 [3]
Silastic (gums)	4.00 [3]
Union Carbide (gums)	4.00 [3]
Union Carbide (compounds)	2.50 [3]

Latex

(per pound carload)

Butadiene-Acrylonitrile Types

Butaprene N-300	.4600 [1]
Butaprene N-400 and N-401	.5400 [1]
Chemigum 200	.4800 [2]
Chemigum 235	.5300 [2]
Chemigum 236	.5300 [2]
Chemigum 245	.4500 [2]
Chemigum 246	.4500 [2]
Chemigum 247	.4500 [2]
Chemigum 248	.4500 [2]
Hycar 1512	.4500 [2]
Hycar 1551	.5300 [2]
Hycar 1552	.4500 [2]
Hycar 1561	.5300 [2]
Hycar 1562	.4500 [2]
Hycar 1571	.5300 [2]
Hycar 1572	.4500 [2]
Hycar 1577	.4500 [2]
Nitrex 2612	.4500 [1]
Nitrex 2616	.5300 [1]
Nitrex 2620	.4500 [1]
Nitrex 2625	.4500 [1]
Tylac 640	.4500 [1]
Tylac 740	.4900 [1]
Tylac 840	.5300 [1]
Tylac 1640	.5400 [1]
Tylac 2241	.5300 [1]
Tylac 2430	.5000 [1]
Tylac 2570	.5300 [1]
Tylac 2830	.4500 [1]

Butadiene-Styrene Types

CL-101 (Shell)	.2800 [2]
Copo 2000	.2775 [2]
Copo 2101	.3000 [2]
Copo 2102	.3200 [2]
Copo 2105	.3200 [2]
Copo 2108	.3000 [2]
Copo 2109	.2775 [2]
Copo 2110	.3200 [2]
Copo 3852	.3000 [2]
FR-S 110	.3000 [2]
FR-S 150	.3000 [2]
FR-S 151	.2900 [2]
FR-S 174	.2950 [2]
FR-S 176	.2775 [2]
FR-S 2000	.2775 [2]
FR-S 2001	.2775 [2]
FR-S 2002	.3000 [2]
FR-S 2003	.3050 [2]
FR-S 2004	.3050 [2]
FR-S 2006	.2900 [2]
FR-S 2105	.3200 [2]
Naugatex 2000	.2775 [1]
Naugatex 2001	.2775 [1]
Naugatex 2002	.3000 [1]
Naugatex 2006	.2900 [1]
Naugatex 2105	.3200 [1]
Naugatex 2107	.3200 [1]
Naugatex 2108	.3000 [1]
Naugatex 2113	.2900 [1]
Naugatex J-8174	.3200 [1]
Naugatex J-8535	.3000 [1]
Pliolite 2000	.2775 [2]
Pliolite 2001	.2775 [2]
Pliolite 2076	.2900 [2]
Pliolite 2104	.3200 [2]
Pliolite 2105	.3200 [2]
Pliolite 2107	.3200 [2]
Pliolite 2108	.3000 [2]
S-2000 and S-2006	.2600 [2]
S-2101	.2600 [2]
S-2105	.2800 [2]
S-2108	.2900 [2]

Neoprene

Neoprene Latex 60	.4000 [2]
Neoprene Latex 571	.3700 [2]
Neoprene Latex 572	.3900 [2]
Neoprene Latex 601-A	.4000 [2]
Neoprene Latex 673	.5000 [2]
Neoprene Latex 735	.3800 [2]
Neoprene Latex 736	.3800 [2]
Neoprene Latex 842-A	.3700 [2]
Neoprene Latex 950	.4700 [2]

Polysulfide Rubbers

Thiokol Type MX	.8000 [2]
Thiokol Type WD-2	1.2500 [2]
Thiokol Type WD-6	.8000 [2]

Notes: (1) Freight allowed. (2) Freight extra. (3) Freight prepaid. *Covers a wide range of compounds. Readers are urged to check specific prices with producers.

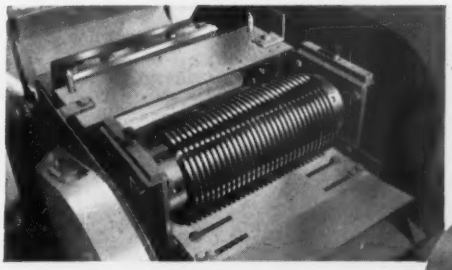

FIG. G-100
GIANT 200 Series Dicer
Made in widths from 18 to 42 inches.
Crosscut 1/64" to 10" or 12".

Taylor-Stiles GIANT Cutters Cut Most Plastics and Rubber Accurately

Taylor-Stiles GIANT Cutters cut rubber and plastics for molding, for making adhesives, for compounding and for extending. For some applications, evenly sized pellets, free from dust and feathers are a must. Taylor-Stiles precision method of positive feeding and shear cutting, the result of years of experience in cutting literally hundreds of products, will increase your output day after day, will reduce your operating cost and will vastly improve your quality. Many of America's largest producers of rubber and plastic stock are turning to these cutters because they require less power to operate and the knives stay sharp longer.

FIG. G-112
Cutting rubber from sheet stock.

FREE SAMPLE CUTTING SERVICE

Many products have individual characteristics that require specialized manufacturing methods. Feel free to call on Taylor-Stiles Engineers no matter what your cutting problem is and no matter what material you plan to cut. Chances are our Testing Department has already had experience in cutting materials similar to your samples.

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RIEGELSVILLE, NEW JERSEY
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INDUSTRIAL CUTTING EQUIPMENT FOR PLASTICS, RUBBER, TEXTILE, PAPER AND OTHER INDUSTRIES; MACHINERY FOR BALE OPENING.

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☐ I would like more information on your rubber cutters.

NAME_____ TITLE_____

COMPANY_____

ADDRESS_____

CITY_____ ZONE_____ STATE_____

MARKETS

(continued)

Reclaimed Rubber

The Rubber Manufacturers Association reports that in the first seven months of the current year a total of 181,446 long tons of reclaimed rubber were produced in the United States against the 175,907 long tons produced in the first seven months of the previous year. As for consumption, in the first seven months of this year, 171,139 long tons of reclaim were consumed, while in the first seven months of 1959, 169,941 long tons were consumed.

It will be seen that while 1960 has, on the whole, been better than 1959, a major improvement does not seem to be in the offing. Has the compact car made a significant contribution to the trend? It would seem so. If the compact car is making for a new background to the marketing scene, reclaimers will have to re-examine their historical positions.

(Prices for All Areas Except Calif.)

	per lb.
Premium Grade Whole Tire	.11½
First Line Whole Tire	.11
Second Line Whole Tire	.10½
Third Line Whole Tire	.10¼
Fourth Line Whole Tire	.09¾
Black Carcass	.15¼
No. 1 Light Colored Carcass	.22
No. 1 Peel	.11
Butyl Tube Reclaim	.14
Natural Rubber Black Tube	.16
Natural Rubber Red Tube	.21
Natural Rubber Gray Tube	.21

Scrap Rubber

As of July 31, 1960, a total of 166,781 long tons of scrap rubber had been consumed in 1960. Scrap rubber consumption is running at close to 24,000 long tons a month, indicating that close to 300,000 long tons of scrap will be consumed this year.

Activity in the scrap rubber market has been moderate for the past few weeks. Several reclaimers have been closing or are now closed for annual vacation periods. As far as prices are concerned, there has been little change. Synthetic tubes have been somewhat easier during the past several days. In other respects, however, the market remains stable and current indications are that this is likely to be the case for the next several weeks.

(Prices Delivered Akron)

Mixed tires	ton	15.00
Light colored carcass	lb.	.05½
No. 1 peelings	ton	45.00
No. 2 peelings	ton	28.00
No. 3 peelings	ton	23.00
Buffings	ton	16.00
Truck and Bus S.A.G.	ton	22.00
Passenger S.A.G.	ton	20.00
Natural Rubber Red Tubes	lb.	.07½
Natural Rubber Black Tubes	lb.	.07
Butyl Rubber Tubes	lb.	.08¼

Tire Fabrics

First quarter production of tire cord and fabric, excluding chafer and similar fabrics, was 107,000,000 pounds, a figure closely comparable to the 109,000,000 pounds produced in the first quarter of 1959. As regards the fibers used, however, there was a decline of 10 per cent in the production of rayon cord and fabric to 69,000,000 pounds, and an increase in nylon usage of 16 per cent to 36,000,000 pounds. The Textile Economics Bureau points out that there has been an almost uninterrupted increase in the production of nylon cord and fabric in each quarter since the first quarter of 1958.

First quarter 1960 production of chafer and similar fabrics amounted to 10,000,000 pounds, a decline from the 13,000,000 pounds produced in the first quarter a year ago. Of the latest quarterly total, 8,000,000 pounds were cotton and 2,000,000 pounds were synthetic fibers.

New Price Cuts

The long price war between manufacturers of nylon and rayon tire yarn has taken another turn. DuPont has announced a 2 to 5c a pound reduction on nylon tire and other industrial yarns effective with shipments of August 11. The cut followed a similar reduction by Tyrex yarn producers the preceding week. The Tyrex price reductions averaged 2½c per pound and were first announced as affecting August deliveries only. In recent days, however, the rayon concerns have given indications that the reductions will stand.

At stake in the price rivalry is leadership in the estimated $300,000,000 tire cord market which has been traditionally dominated by rayon cord. First quarter production figures noted earlier, however, and the trend which has been in evidence since the first quarter of 1958, may be an indication of the way things are going. Further cuts may be in the offing for there is a determination on both sides to meet competition.

(Prices f.o.b. Shipping Point)

Rayon Tire Cord

1100	lb.	.62½
1650	lb.	.62
2200	lb.	.62½

Nylon Tire Cord

210	lb.	1.75
840	lb.	1.47

Rayon Graded Fabric

1100	lb.	.69
1650	lb.	.63¼
2200	lb.	.63

Cotton Chafers

8.9 oz. (per square yard)	lb.	.71
9.25 oz. (per square yard)	lb.	.72
11.65 oz. (per square yard)	lb.	.66
14.4 oz. (per square yard)	lb.	.75

Liquid Latex

Natural: The Rubber Manufacturers Association reports that in the first seven months of the current year, 34,268 long tons of natural rubber latex were imported into the United States, or about 12,500 long tons less than were imported in the first seven months of the preceding year.

A total of 30,355 long tons of natural rubber latex were consumed in the first seven months of 1960, compared with the 42,573 long tons consumed in the corresponding period of 1959. As of July 31, 1960, there were 19,570 long tons of natural rubber latex in stocks on hand.

Natural rubber latex is currently selling at a 42 to 43c level at East Coast ports in car load lots. Although the present price level is now lower than it has been for some months, it is doubtful if natural latex, at this point will regain its former statistical position. Buying habits, once established, are rather difficult to break.

Synthetic: Production of synthetic latices in the United States is running at about 11,000 long tons per month. At this rate, something over 130,000 long tons will be produced in the United States this year, a new record.

Consumption of synthetic latices is running at a 9,500 tons per month level indicating that consumption this year will probably approach a 115,000 long ton level. This too will represent a new high.

Cotton

The price of middling uplands on the New York Cotton Exchange has moved in a range of 80 points since our last report (August 1), high for the period being 33.20c reached on August 1, and low being 32.40c reached on August 19 and on five other days during the month. The average price of middling uplands for the month of August was 32.59c based on 23 trading days. This compares with an average of 33.96c in the previous month.

The cotton carryover in the Free World as of August 1, 1960, is estimated at 16,400,000 bales by the International Cotton Advisory Committee. This is 1,300,000 bales smaller than a year earlier and compares with stocks of 18,700,000 bales on August 1, 1958.

The estimated Free World supply for the season ended July 31, 1960, was 48,700,000 bales, with beginning stocks of 17,700,000 bales and production of 31,000 bales. Free World disappearance last season totaled approximately 32,300,000 bales, a record high.

Cotton productions in the Free World this season is expected to be slightly larger than during the 1959-60 season. Due to smaller carryover stocks, however, total Free World supply may not be much different than in the past season, many in the trade believe.

The current political scene, of course, is having an effect upon the psychology of the market. What will the new farm program be? That is the question upon which much hinges.

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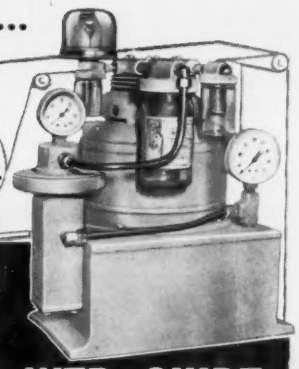

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STATISTICS of the industry

PERTINENT INDUSTRY DATA

Natural Rubber in the United States

(Including Latex and Guayule)

(All Quantities in Long Tons)

Year	New Supply	Consumption	Re-Exports	Stocks On Hand at End of Period
1931	501,788	355,200	25,609	322,000
1932	414,668	336,700	20,937	379,000
1933	418,902	412,400	20,576	365,000
1934	463,018	462,500	23,856	355,000
1935	467,146	495,500	11,391	303,000
1936	488,145	575,000	12,582	223,000
1937	600,479	543,600	7,902	262,204
1938	411,983	437,031	5,652	231,500
1939	499,473	592,000	13,125	125,800
1940	818,243	648,500	7,060	288,864
1941	1,029,007	775,000	5,376	533,344
1942	282,653	376,791	10,856	422,714
1943	55,329	317,634	20,815	139,594
1944	107,834	144,113	9,665	93,650
1945	135,672	105,429	6,743	118,715
1946	400,687	277,597	4,338	237,467
1947	688,354	562,661	4,101	129,038
1948	735,227	627,332	6,673	141,541
1949	660,792	574,522	6,253	106,619
1950	802,249	720,268	8,644	89,215
1951	733,048	454,015	2,603	76,569
1952	805,997	453,846	3,024	95,260
1953	647,150	553,472	8,376	112,316
1954	596,848	596,285	7,443	104,543
1955	635,174	634,800	10,611	110,105
1956	580,510	563,095	11,300	115,949
1957	499,121	539,761	10,146	100,901
1958	474,409	484,492	20,085	76,491
1959	526,048	555,044	18,750	79,405
1959:				
Nov.	48,844	42,039	1,414	78,503
Dec.	47,444	42,950	1,139	79,405
1960:				
Jan.	43,140	46,771	1,100	76,877
Feb.	41,042	46,155	1,700	74,230
Mar.	43,707	47,205	1,522	81,599
Apr.	42,768	42,032	803	83,451
May		41,263		82,693

Source: U. S. Department of Commerce.

U. S. Imports of Natural Rubber

Year	Dry: Long Tons	Dry: Declared Value	Latex: Long Tons	Latex: Declared Value	Total Imports
1936	467,064	152,072,496	19,852	6,659,899	486,916
1937	574,600	237,307,041	23,185	10,213,670	597,785
1938	397,640	125,373,864	11,944	4,168,127	409,584
1939	469,946	167,586,780	27,437	10,467,552	497,383
1940	781,202	303,308,823	33,789	14,593,466	814,991
1941	989,498	401,976,317	34,797	15,965,627	1,024,245
1942	266,276	112,537,426	10,646	5,630,667	276,922
1943	50,358	31,369,198	1,890	1,312,202	52,248
1944	103,847	73,908,549	3,091	2,092,211	106,938
1945	134,408	95,814,102	4,773	3,115,853	139,181
1946	376,502	228,796,110	8,421	5,843,085	384,923
1947	691,087	306,951,814	17,542	9,787,722	708,629
1948	702,293	290,849,177	32,745	18,288,223	735,038
1949	630,808	225,343,624	29,743	14,968,650	660,551
1950	747,109	416,222,598	54,401	41,764,486	801,510
1951	677,874	727,343,348	54,963	80,178,309	732,837
1952	756,987	578,179,519	48,228	40,563,116	805,215
1953	571,635	284,909,223	75,511	46,353,333	647,146
1954	522,364	219,098,143	74,483	42,755,029	596,847
1955	542,507	360,435,303	92,825	80,163,114	635,332
1956	499,479	334,990,045	71,709	61,795,844	564,321
1957	475,958	291,337,628	78,567	58,249,788	554,174
1958	406,059	153,127,066	67,593	45,047,040	473,652
1959	498,749	304,594,223	79,205	60,939,662	577,954
1960:					
Jan.	29,455	22,167,388	5,340	4,690,413	34,795
Feb.	35,137	27,281,957	5,812	5,411,873	40,949
Mar.	33,453	26,696,437	5,128	4,659,021	38,581
Apr.	31,408	25,659,607	4,940	4,690,140	36,348
May	26,637	21,962,099	5,830	4,853,091	32,467

Source: Bureau of the Census, U. S. Department of Commerce.

World Production of Natural Rubber

(Including Latex)

(Long Tons)

Year	Malaya	Indonesia	Ceylon	Viet Nam & Cambodia	Latin America*	Rest of World*	Total*
1947	646,362	277,951	89,000	38,128	34,928	172,782	1,260,000
1948	698,189	432,349	95,000	43,935	29,158	225,557	1,525,000
1949	671,503	432,996	89,500	43,010	27,318	225,659	1,490,000
1950	694,090	696,472	113,500	48,482	26,902	280,299	1,860,000
1951	605,346	814,406	105,000	52,136	29,777	278,262	1,885,000
1952	584,238	750,494	96,500	63,134	35,475	261,211	1,790,000
1953	574,390	692,164	98,610	74,545	35,318	250,182	1,725,000
1954	584,435	738,670	93,935	78,024	26,833	280,112	1,802,500
1955	639,128	733,786	93,830	80,172	6,000	344,584	1,897,500
1956	568,550	686,667	95,389	89,072	22,457	336,015	1,857,000
1957	638,706	684,515	98,164	58,440	28,351	381,824	1,890,000
1958	663,644	614,561	100,196	103,613	26,268	446,718	1,955,000
1959	698,249	721,359	91,696	108,398	23,962	421,336	2,065,000
1960:							
Jan.	64,948	45,928	10,875	10,305	4,003	33,941	170,000
Feb.	54,544	50,274	4,285	949	3,667	38,781	152,500
Mar.	54,946	50,567	10,199	2,941	600	38,247	157,500
Apr.	46,917	55,143	9,006	7,415	600	33,419	152,500

Source: International Rubber Study Group. * Estimated.

World Consumption of Natural and Synthetic Rubber

(Including Latex)

(Long Tons)

Year	United States	United Kingdom	Canada	Europe*	Rest of World*	Total*
1946	1,039,296	126,770	39,196	145,000	115,804	1,467,500
1947	1,122,327	156,399	61,452	242,500	153,548	1,735,000
1948	1,069,404	196,286	62,121	392,000	182,379	1,902,500
1949	988,903	186,622	56,362	446,500	207,388	1,887,500
1950	1,258,557	222,425	68,695	448,500	287,055	2,285,000
1951	1,214,298	238,101	70,809	476,500	314,941	2,312,500
1952	1,261,413	202,179	67,099	550,000	254,901	2,335,000
1953	1,338,309	211,453	73,394	521,000	343,606	2,500,000
1954	1,233,012	247,612	71,656	544,250	408,094	2,505,000
1955	1,529,699	266,804	84,528	630,000	464,250	2,980,000
1956	1,436,482	232,345	91,458	775,500	489,215	3,025,000
1957	1,464,640	239,021	88,379	777,250	565,710	3,135,000
1958	1,364,404	238,439	83,904	905,000	638,353	3,230,000
1959	1,626,370	259,655	101,484	985,250	689,741	3,662,500
1960:						
Jan.	141,487	23,087	8,138	82,750	69,538	325,000
Feb.	139,225	22,861	8,733	78,000	66,181	315,000
Mar.	144,932	27,853	8,872	80,500	52,843	315,000
Apr.	132,284	21,946	7,106	.....	141,164	302,500

Source: International Rubber Study Group. * Estimated.

Rim Production

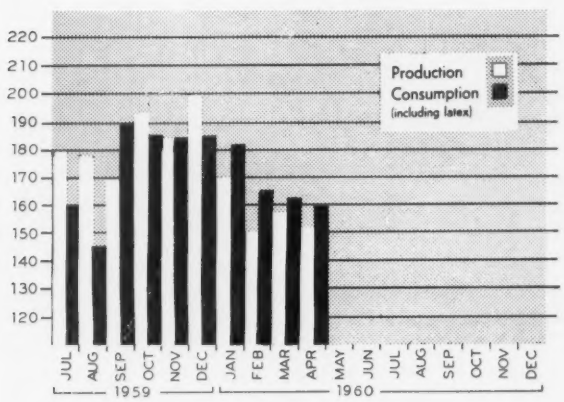
	1955	1956	1957	1958	1959
Passenger Car	38,092,080	27,109,610	27,301,567	20,665,688	25,412,177
Truck & Bus	6,642,329	6,315,428	5,468,223	3,887,910	5,019,261
Agricultural	1,931,768	1,416,938	1,368,127	1,218,240	1,386,866
Earth Mover	38,849	88,812	67,289	61,883	111,077
Total	46,705,036	34,930,788	34,205,206	25,833,721	31,929,381

	1960					
	Feb.	Mar.	Apr.	May	June	July
Passenger Car	3,162,583	2,876,851	2,358,563	2,605,253	2,473,789	1,551,209
Truck and Bus	602,427	551,323	397,705	426,956	426,862	343,817
Agricultural	153,386	115,565	85,504	87,838	79,521	24,771
Earth Mover	8,339	9,602	12,921	10,979	8,273	4,532
Total	3,926,754	3,533,341	2,854,693	3,136,026	2,988,445	1,924,329

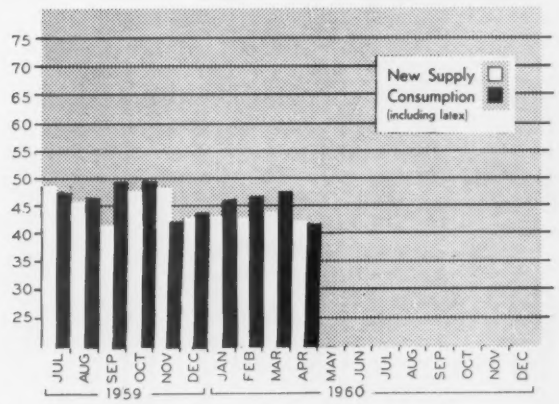
Source: The Tire & Rim Association, Inc.

STATISTICS at a glance

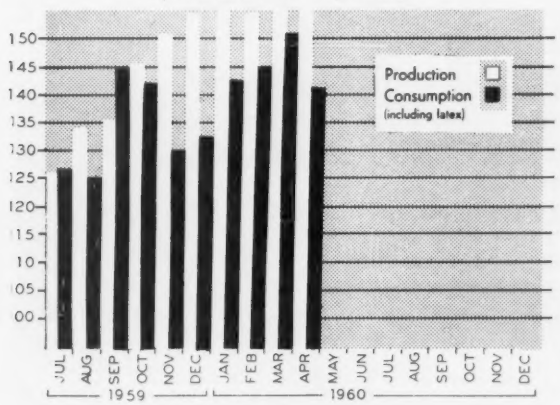
NATURAL RUBBER—WORLD
(thousands of long tons)



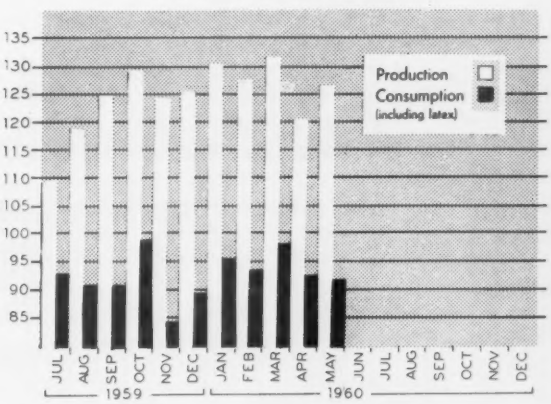
NATURAL RUBBER—UNITED STATES
(thousands of long tons)



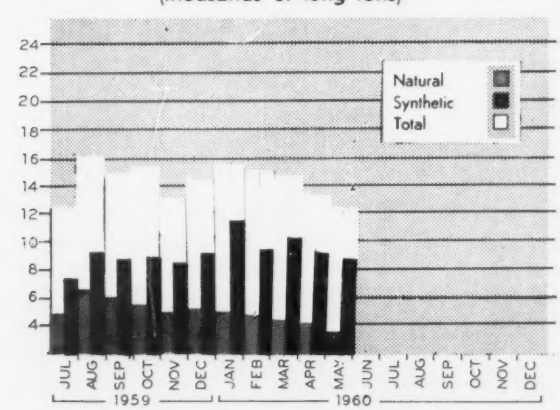
SYNTHETIC RUBBER—WORLD
(thousands of long tons)



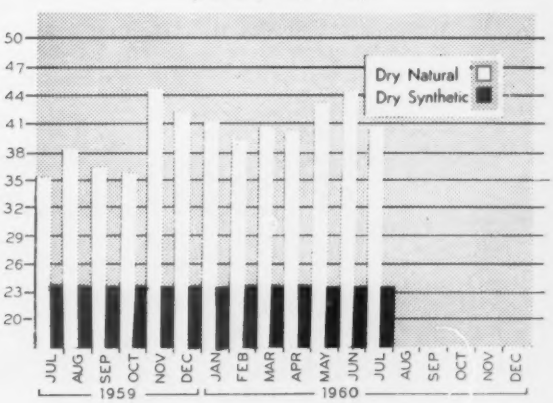
SYNTHETIC RUBBER—UNITED STATES
(thousands of long tons)



LATEX CONSUMPTION—UNITED STATES
(thousands of long tons)



PRICES—NATURAL AND SYNTHETIC
(cents per pound)



Synthetic Rubber in the United States

(All Quantities in Long Tons)

New Supply

Year	GR-S	Neoprene	Butyl	N-Type	Total
1949	310,539	35,213	54,046	11,072	410,932
1950	378,887	50,067	60,915	12,037	501,906
1951	704,529	58,907	76,475	15,333	855,244
1952	654,854	65,745	81,630	16,228	818,447
1953	680,728	80,495	79,801	20,198	861,222
1954	490,405	69,150	58,802	21,396	639,753
1955	801,145	91,357	56,179	32,623	982,304
1956	876,982	99,412	75,873	34,547	1,086,814
1957	913,321	110,721	67,418	33,618	1,125,078
1958	872,565	97,806	54,113	32,431	1,056,915
1959	1,134,379	124,815	82,704	43,588	1,385,486
1959:					
Nov.	102,325	11,660	7,714	3,827	125,526
Dec.	102,157	11,475	8,661	3,486	125,779
1960:					
Jan.	107,519	11,958	8,325	3,808	131,610
Feb.	105,030	12,106	6,917	3,126	127,179
Mar.	110,239	11,305	7,828	3,613	132,985
Apr.	98,464	11,879	8,144	3,130	121,617
May	102,501	11,401	9,814	3,088	126,804

Consumption

1960	416,230	43,781	66,348	11,930	538,289
1951	626,444	48,887	70,500	13,066	758,897
1952	666,420	55,522	71,229	13,866	807,037
1953	624,181	65,900	77,826	16,929	784,836
1954	500,345	57,203	61,464	17,715	636,727
1955	741,997	72,876	53,991	26,035	894,899
1956	727,789	74,887	49,615	24,976	877,267
1957	767,218	75,461	55,413	25,187	923,279
1958	730,196	69,694	53,432	26,590	880,912
1959	886,275	84,955	65,454	34,638	1,071,322
1959:					
Oct.	81,963	7,538	5,965	3,128	98,594
Nov.	69,217	6,684	5,327	2,655	83,883
Dec.	73,871	6,996	5,489	2,696	89,052
1960:					
Jan.	78,891	7,361	6,093	2,788	95,133
Feb.	76,999	7,369	6,070	2,765	93,203
Mar.	81,065	7,693	6,324	2,645	97,727
Apr.	75,849	6,525	5,492	2,386	90,252
May	77,423	6,471	5,602	2,497	91,993

Exports

1950	900	4,826	31	1,895	7,652
1951	483	6,825	216	1,725	9,249
1952	9,467	9,813	126	2,695	22,101
1953	7,692	11,494	237	3,245	22,668
1954	11,069	12,062	2,831	4,155	30,117
1955	60,704	18,098	9,895	4,593	93,290
1956	112,366	21,909	8,699	6,194	149,168
1957	157,977	30,242	8,748	6,377	203,344
1958	142,069	31,337	13,793	6,718	193,917
1959	211,300	39,551	21,700	8,256	280,843
1959:					
Oct.	13,476	2,250	1,383	679	17,788
Nov.	18,916	3,362	1,242	648	24,168
Dec.	25,392	4,662	1,265	1,031	32,350
1960:					
Jan.	21,967	4,185	2,396	527	29,075
Feb.	22,791	4,588	1,528	740	29,647
Mar.	27,081	4,874	1,803	532	34,290
Apr.	28,765	5,268	2,006	676	36,715

Stocks

1949	77,731	4,654	12,224	3,433	98,042
1950	36,942	5,733	7,243	2,840	52,758
1951	105,271	8,379	12,481	3,821	129,912
1952	83,861	8,535	22,716	3,875	118,987
1953	135,153	11,480	24,866	4,346	175,845
1954	115,499	11,349	19,267	4,280	150,395
1955	108,989	12,220	10,500	6,030	137,739
1956	151,763	14,077	28,744	7,934	202,518
1957	140,199	18,843	31,489	7,454	197,985
1958	143,533	15,688	18,770	7,292	185,283
1959	174,606	14,164	13,188	8,888	210,846
1959:					
Dec.	174,606	14,164	13,188	8,888	210,846
1960:					
Jan.	183,242	15,143	14,039	9,198	221,622
Feb.	186,166	13,930	12,735	8,352	221,183
Mar.	189,308	13,491	12,764	8,175	223,738
Apr.	185,464	13,796	14,021	8,230	221,511
May	188,808	14,243	16,014	8,267	227,332

Source: U. S. Department of Commerce.

Natural and Synthetic Rubber Latex in the United States

(All Quantities in Long Tons)

New Supply

Year	Natural	GR-S	Neoprene	N-Type	Total Synthetic	Grand Total
1945	4,768	15,176	7,077	.....	22,253	27,021
1946	8,012	24,810	13,595	.....	38,405	46,417
1947	17,675	22,474	6,089	.....	28,563	46,238
1948	32,630	21,494	5,022	.....	26,516	59,146
1949	29,974	21,357	3,651	.....	25,008	54,982
1950	54,401	31,339	5,725	.....	37,064	91,465
1951	54,963	32,972	6,866	2,948	42,786	97,749
1952	48,228	42,273	7,598	4,164	54,035	102,263
1953	75,511	48,112	9,026	5,844	62,982	138,493
1954	74,483	48,379	8,214	6,866	63,459	137,942
1955	92,754	69,364	10,432	10,798	90,594	183,348
1956	72,013	69,720	10,642	10,650	91,012	163,025
1957	72,252	74,535	10,403	11,420	96,358	168,610
1958	67,591	65,669	10,679	11,560	87,908	155,499
1959	72,502	93,303	13,127	14,034	120,464	192,966
1959:						
Oct.	6,747	9,424	1,020	1,187	11,631	18,378
Nov.	5,055	8,144	1,206	1,104	10,454	15,509
Dec.	6,705	8,429	1,017	1,045	10,491	17,196
1960:						
Jan.	5,339	9,720	1,154	1,131	12,005	17,344
Feb.	5,812	9,862	1,085	1,098	12,045	17,857
Mar.	5,127	9,351	1,004	1,217	11,572	16,699
Apr.	4,935	9,408	1,137	917	11,462	16,397
May	....	8,162	1,250	1,009	10,421	10,421

Consumption[1]

1945	3,886	14,500	6,800	....	21,300	25,186
1946	5,714	23,500	13,000	....	36,500	42,214
1947	13,909	22,500	6,500	....	29,000	42,909
1948	28,489	21,500	5,250	....	26,750	55,239
1949	36,117	21,500	3,750	....	25,250	61,367
1950	56,138	31,000	5,500	....	36,500	92,638
1951	46,750	31,031	6,279	2,628	39,938	86,688
1952	53,567	40,562	7,368	3,093	51,023	104,590
1953	67,375	46,473	7,981	3,654	58,108	125,483
1954	75,931	44,173	7,251	4,507	55,931	131,862
1955	86,478	63,982	8,736	8,495	81,213	167,691
1956	74,082	62,762	8,708	8,021	79,491	153,573
1957	75,009	68,305	9,039	8,630	85,974	160,983
1958	70,183	60,283	9,555	10,549	80,387	150,570
1959	71,745	80,646	11,394	13,258	105,298	177,043
1959:						
Oct.	6,153	7,388	969	1,158	9,515	15,668
Nov.	4,858	6,427	893	981	8,301	13,159
Dec.	5,206	7,428	895	993	9,316	14,522
1960:						
Jan.	5,491	8,094	999	1,117	10,210	15,701
Feb.	5,463	7,838	969	1,000	9,807	15,270
Mar.	4,847	8,104	1,076	927	10,107	14,954
Apr.	4,199	7,154	913	976	9,043	13,242
May	3,655	6,821	868	978	8,667	12,322

Stocks at End of Period

1945	3,121	....	....	....	....	3,121
1946	4,865	....	....	....	....	4,865
1947	5,033	....	....	....	....	5,033
1948	11,235	....	....	....	....	11,235
1949	5,063	....	....	....	....	5,063
1950	4,927	....	....	....	....	4,927
1951	4,752	3,727	1,245	532	5,504	10,256
1952	6,201	5,040	1,019	902	6,961	13,162
1953	13,532	4,794	1,117	721	6,632	20,164
1954	11,133	5,134	1,087	811	7,032	18,165
1955	13,203	6,980	1,236	1,807	10,203	23,406
1956	12,064	7,451	1,384	1,558	10,393	22,457
1957	14,454	8,347	1,267	1,974	11,588	26,042
1958	8,900	7,672	1,663	2,519	11,854	20,754
1959	12,717	8,226	1,581	2,883	12,690	25,067
1959:						
Oct.	12,220	7,570	1,464	2,888	11,922	24,142
Nov.	11,707	8,279	1,451	2,975	12,705	24,412
Dec.	12,717	8,228	1,581	2,883	12,690	25,067
1960:						
Jan.	12,781	7,781	1,680	2,799	12,260	25,041
Feb.	12,974	8,606	1,534	2,535	12,675	25,649
Mar.	13,964	8,055	1,518	2,492	12,065	26,029
Apr.	13,896	9,081	1,595	2,242	12,918	26,814
May	15,214	10,031	1,745	2,342	14,118	29,332

Source: U. S. Department of Commerce.
Note: (1) GR-S and Neoprene consumption estimated through 1950.

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NATURAL CRUDE RUBBER IN LIQUID FORM 100% SOLIDS

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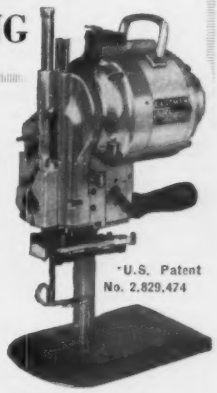

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- All types of Coated materials
- Rubber Sheeting and Slabs

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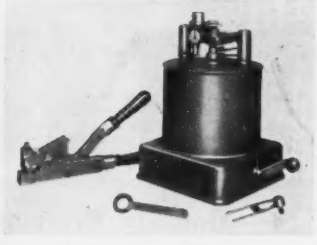

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PLASTIMETER TESTS IN LESS THAN ONE MINUTE!
NO CLEANING NECESSARY BETWEEN TESTS!

A simple, rapid, fully automatic test for measuring plasticity of unvulcanized rubber.

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TESTING MACHINES, INC.

Rubber Industry Employment Earnings and Hours

All Rubber Products

Mo.	1959 Production Workers (thousands)	1959 Average Weekly Earnings	1959 Average Weekly Hours	1959 Average Hourly Earnings	1960 Production Workers (thousands)	1960 Average Weekly Earnings	1960 Average Weekly Hours	1960 Average Hourly Earnings
Jan.	199.1	$100.28	41.1	$2.45	208.0	$102.16	40.7	$2.51
Feb.	198.8	101.09	41.6	2.44	208.6	100.00	40.0	2.50
Mar.	201.5	103.74	42.0	2.43	207.5	97.71	39.4	2.48
Apr.	176.0	101.57	41.8	2.47	200.4	94.35	38.2	2.47
May	171.8	101.46	42.1	2.43	197.8	.....	...	...
June	196.1	98.74	40.3	2.45	....	.....	...	...
July	203.4	107.10	42.5	2.52	....	.....	...	...
Aug.	203.8	105.53	42.3	2.49	....	.....	...	...
Sept.	212.4	102.01	41.3	2.47	....	.....	...	...
Oct.	212.3	101.18	40.8	2.48	....	.....	...	...
Nov.	209.1	97.66	39.7	2.46	....	.....	...	...
Dec.	208.0	101.59	40.8	2.49	....	.....	...	...
Tires and Tubes								
Jan.	76.9	117.55	41.1	2.87	77.9	119.80	40.2	2.98
Feb.	76.2	118.98	41.6	2.86	77.4	117.71	39.5	2.98
Mar.	77.9	122.96	42.4	2.86	78.8	113.68	38.8	2.93
Apr.	66.0	123.98	42.9	2.90	78.1	106.51	36.6	2.91
May	52.2	126.13	42.9	2.89	....	.....	...	...
June	70.7	108.93	36.8	2.96	....	.....	...	...
July	79.7	128.74	43.2	2.98	....	.....	...	...
Aug.	78.4	127.74	43.3	2.95	....	.....	...	...
Sept.	80.5	117.56	40.4	2.91	....	.....	...	...
Oct.	79.7	117.49	40.1	2.93	....	.....	...	...
Nov.	79.0	112.62	38.7	2.91	....	.....	...	...
Dec.	78.1	118.59	40.5	2.94	....	.....	...	...
Rubber Footwear								
Jan.	17.1	78.20	39.9	1.96	19.0	79.40	39.5	2.01
Feb.	17.1	80.59	40.7	1.96	19.0	77.21	38.8	1.99
Mar.	17.4	79.79	40.3	1.98	18.9	78.61	39.5	1.99
Apr.	12.9	73.05	39.7	1.98	18.5	75.65	38.4	1.97
May	17.7	79.58	40.6	1.84	....	.....	...	...
June	18.2	81.58	41.2	1.98	....	.....	...	...
July	18.3	78.60	40.1	1.96	....	.....	...	...
Aug.	18.4	79.17	40.6	1.95	....	.....	...	...
Sept.	19.0	79.18	40.4	1.96	....	.....	...	...
Oct.	19.1	79.40	39.9	1.99	....	.....	...	...
Nov.	19.6	79.80	39.9	2.00	....	.....	...	...
Dec.	19.4	80.79	39.9	2.04	....	.....	...	...
All Other Rubber Products								
Jan.	105.1	91.27	41.3	2.21	111.1	93.52	41.2	2.27
Feb.	105.5	91.96	41.8	2.21	112.2	91.76	40.6	2.26
Mar.	106.2	93.02	41.9	2.20	109.8	89.78	39.9	2.25
Apr.	97.1	90.03	41.3	2.22	103.8	88.65	39.4	2.25
May	101.9	92.18	41.9	2.18	....	.....	...	...
June	107.2	94.98	42.4	2.24	....	.....	...	...
July	105.4	95.40	42.4	2.25	....	.....	...	...
Aug.	107.0	93.21	41.8	2.23	....	.....	...	...
Sept.	112.9	94.73	42.1	2.25	....	.....	...	...
Oct.	113.5	93.38	41.5	2.25	....	.....	...	...
Nov.	110.5	89.87	40.3	2.23	....	.....	...	...
Dec.	110.5	92.93	41.2	2.25	....	.....	...	...

Source: U. S. Department of Labor.

Note: Data are based upon reports from cooperating establishments covering both full and part-time employees who work during, or received pay for, any part of the pay period ending nearest the 15th of the month. These employment series have been adjusted to first quarter 1954 benchmark levels indicated by data from government social insurance programs. Hours and earnings data pertain only to production and related workers.

Spot Closing Cotton Prices

(Middling Upland Grade—New York Market—in Cents)

Average Monthly Price Per Pound

	1953	1954	1955	1956	1957	1958	1959	1960
Jan.	33.24	34.16	35.07	35.24	34.82	36.31	35.67	33.09
Feb.	33.76	35.00	35.04	36.26	34.82	35.83	35.69	33.20
Mar.	34.10	35.23	34.33	36.70	35.35	36.05	35.71	33.54
Apr.	33.85	35.22	34.23	36.43	35.43	36.00	36.05	34.10
May	34.30	35.34	34.80	36.65	35.40	36.27	36.24	34.15
June	34.11	35.17	34.83	36.67	35.45	36.33	36.05	34.22
July	34.20	35.37	34.61	35.43	35.49	36.51	34.67	33.96
Aug.	33.82	35.19	34.53	34.31	35.15	36.36	33.17	32.59
Sept.	33.69	35.46	33.85	34.35	34.74	36.00	32.99	....
Oct.	33.53	35.24	33.93	34.45	35.09	36.23	32.77	....
Nov.	33.60	34.80	34.87	34.56	36.06	36.24	32.79	....
Dec.	33.52	35.03	34.95	34.56	36.50	35.75	33.02	....
Average for Year	33.81	35.10	34.59	35.50	35.36	36.16	34.57	....

Note: The Government established a ceiling of 45.76c for spot cotton on March 3, 1951. (a) Trading suspended during February.

Production Index for the Rubber Industry

(1957 = 100)

(Based on man-hours)

	1958	1959	1960		1958	1959	1960
Jan.	116	108	118	July	125	128	...
Feb.	114	113	117	Aug.	131	120	...
Mar.	116	112	115	Sept.	136	120	...
Apr.	112	104	115	Oct.	133	115	...
May	113	105	117	Nov.	141	113	...
June	125	117	...	Dec.	140	116	...

Sales by the Rubber Industry

(in Millions of Dollars*)

	1958	1959	1960		1958	1959	1960
Jan.	448	508	530	July	478	519	...
Feb.	413	490	570	Aug.	438	492	...
Mar.	396	506	510	Sept.	464	544	...
Apr.	429	543	530	Oct.	493	555	...
May	428	524	550	Nov.	472	482	...
June	445	520	520	Dec.	518	500	...

Rubber Manufacturers' Inventories

(in Millions of Dollars*)

	1958	1959	1960		1958	1959	1960
Jan.	1,100	998	1,140	July	980	1,075	...
Feb.	1,087	1,022	1,140	Aug.	1,024	1,113	...
Mar.	1,069	1,030	1,160	Sept.	1,024	1,114	...
Apr.	1,047	1,015	1,190	Oct.	1,022	1,115	...
May	1,020	995	1,180	Nov.	1,018	1,120	...
June	986	1,013	1,210	Dec.	994	1,140	...

Source: U. S. Department of Commerce.
Notes: * Adjusted for seasonal variation.

No. 1 R.S.S.—Annual Average Prices

(New York Market—Cents per Pound)

Year	High	Low	Avg.	Year	High	Low	Avg.
1918	70	40	60.15	1939	24	14¼	17.57
1919	57	38½	48.70	1940	24	18¾	20.10
1920	56½	16	36.30	1941	24⅞	19⅜	22.40
1921	21¾	11½	16.36	1942	22½	22½	22.50
1922	28⅜	13⅜	17.50	1943	22½	22½	22.50
1923	37⅛	24¾	29.45	1944	22½	22½	22.50
1924	40⅛	17⅜	26.20	1945	22½	22½	22.50
1925	121	34⅜	72.46	1946	22½	22½	22.50
1926	88½	36¾	48.50	1947	25	14	20.00
1927	41¾	33	37.72	1948	25	18	21.99
1928	41¾	17	22.48	1949	19¾	15⅞	17.57
1929	26⅞	15½	20.55	1950	86	18	41.10
1930	16½	7½	11.98	1951	76	52	(a)
1931	8⅜	4¼	6.17	1952*	33	26½	29.15
1932	4¼	2½	3.49	1953	31⅞	19⅞	24.21
1933	9⅞	2⅞	5.96	1954	34½	19½	23.61
1934	15⅞	8¾	12.92	1955	52	29⅜	39.16
1935	13¾	10½	12.37	1956	45	26½	34.24
1936	23	13½	16.41	1957	37⅜	26⅜	31.13
1937	26⅞	14	19.39	1958	32⅝	24⅜	28.13
1938	17⅛	10¼	14.64	1959	49	29¾	36.56

Note: Price was fixed by Government on August 6, 1941, at 22½c a pound for non-war uses. Free trading was resumed May 1, 1947. (a) Free trading suspended March 31, 1951. GSA selling price ranged between 52 and 60c during balance of year. * Free trading was resumed on July 1, 1952; figures represent only July through December, 1952.

No. 1 R.S.S.—Monthly Average Prices

(New York Market—Cents per pound)

	1953	1954	1955	1956	1957	1958	1959	1960
Jan.	29.40	20.22	33.92	41.70	33.32	27.15	30.34	41.18
Feb.	27.57	19.98	34.90	33.68	30.43	26.32	30.26	39.33
Mar.	26.59	20.16	31.08	33.68	31.76	26.65	31.62	40.74
Apr.	24.66	22.06	31.75	31.75	32.23	26.44	33.72	40.35
May	25,52	21,96	31.35	29.61	32.12	25.51	36.48	43.62
June	24.42	23.01	34.74	30.54	32.80	26.20	34.31	45.70
July	23.64	24.12	40.84	33.91	32.88	27.70	35.19	40.90
Aug.	23.06	23.00	48.85	35.69	32.13	28.72	38.43	36.69
Sept.	23.06	23.00	48.27	32.64	29.94	29.49	40.22	....
Oct.	20.82	26.57	43.81	32.68	29.24	31.06	41.50	....
Nov.	20.58	28.07	44.95	35.18	27.47	32.10	45.16	....
Dec.	20.92	29.88	48.40	37.01	29.25	30.28	41.46	....
Average for Year	24.21	23.61	39.16	34.24	31.13	28.13	36.56	....

Note: (*) Free trading suspended March 31, 1951, and resumed on July 1, 1952.

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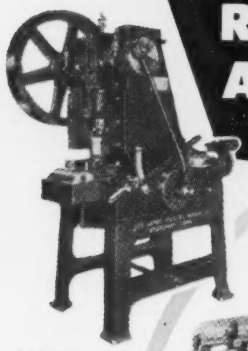
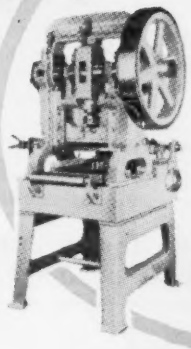
Coulter precision rubber cutting machines give you a double edge in cutting costs



MODEL A1
Precision cutting for both high speed production or short runs.



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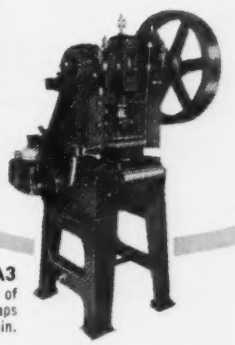
Precision cutting for multiple heels, half and full soles with stock grain.



MODEL A3
Precision cutting of multiple heels and taps with or across stock grain.

Cutting on a Coulter is efficiency in action

Cutting speeds up to 15,000 pieces per hour boost your production while Coulter's job designed machines yield a low maintenance record

the James COULTER Machine Co. BRIDGEPORT, CONN.

PRECISION RUBBER CUTTING MACHINES CUT WITH OR ACROSS STOCK GRAIN

- Peak production loads
- Short runs
- Multiple heels and taps
- Half and full soles
- Mechanical rubber goods

Serving the rubber industry with efficiency since 1896

See your local distributor or write today for full information.

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RIDACTO®

"the proven Accelerator Activator Since 1944"

RIDACTO is especially effective in equalizing the vulcanization of mixtures of SBR and natural rubber. RIDACTO is more active toward SBR and consequently serves to balance the vulcanization of the two rubber hydrocarbons.

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SPENCER PRODUCTS CO., INC.

P. O. BOX 339 RIDGEWOOD, NEW JERSEY

Automotive Pneumatic Casings

(Thousands of Units)

	Shipments					
	Original Equipment	Replacement	Export	Total	Production	Inventory End of Period
1951 (total)	**32,153**	**44,612**	**1,677**	**78,442**	**83,405**	**8,765**
Passenger Car	26,729	34,226	723	61,678	65,546	6,973
Truck and Bus	5,424	10,386	954	16,764	17,859	1,791
1952 (total)	**29,484**	**54,342**	**1,520**	**85,346**	**90,411**	**14,110**
Passenger Car	24,106	45,458	741	70,305	74,341	11,251
Truck and Bus	5,378	8,884	779	15,041	16,070	2,859
1953 (total)	**37,949**	**55,124**	**1,543**	**94,617**	**96,150**	**15,720**
Passenger Car	33,106	45,798	809	79,713	81,455	13,044
Truck and Bus	4,843	9,326	734	14,904	14,696	2,676
1954 (total)	**33,333**	**55,155**	**1,753**	**90,241**	**89,141**	**14,762**
Passenger Car	29,741	47,044	928	77,713	76,794	12,217
Truck and Bus	3,591	8,111	826	12,528	12,347	2,545
1955 (total)	**47,374**	**59,246**	**1,879**	**108,499**	**112,178**	**18,778**
Passenger Car	42,574	50,189	966	93,730	97,223	15,963
Truck and Bus	4,800	9,057	912	14,769	14,955	2,815
1956 (total)	**35,422**	**62,146**	**1,757**	**99,325**	**100,406**	**79,872**
Passenger Car	30,873	53,252	875	85,000	85,546	16,494
Truck and Bus	4,548	8,894	883	14,325	14,859	3,378
1957 (total)	**36,765**	**65,150**	**1,733**	**103,649**	**106,940**	**250,536**
Passenger Car	32,725	56,603	889	90,217	93,542	210,146
Truck and Bus	4,053	8,546	846	13,432	13,398	40,384
1958 (total)	**26,783**	**70,797**	**1,348**	**98,928**	**96,563**	**20,939**
Passenger Car	23,408	61,570	717	85,696	83,636	17,778
Truck and Bus	3,375	9,226	631	13,232	12,927	3,161
1959 (total)	**34,163**	**76,812**	**1,430**	**112,405**	**117,875**	**26,933**
Passenger Car	29,746	66,797	786	97,329	102,637	23,578
Truck and Bus	4,417	10,015	644	15,076	15,238	3,355
1959:						
Sept. (total)	2,345	6,819	135	9,298	10,103	22,542
Passenger Car	1,923	5,850	77	7,850	8,804	19,636
Truck and Bus	422	969	58	1,448	1,299	2,906
Oct. (total)	2,966	7,166	136	10,269	10,884	23,151
Passenger Car	2,628	6,015	79	8,722	9,374	20,287
Truck and Bus	338	1,151	57	1,547	1,510	2,864
Nov. (total)	1,440	4,898	120	6,458	8,347	25,133
Passenger Car	1,252	4,161	64	5,476	7,088	21,996
Truck and Bus	189	737	56	982	1,259	3,137
Dec. (total)	3,197	4,565	180	7,942	9,645	26,933
Passenger Car	2,912	3,826	105	6,844	8,344	23,578
Truck and Bus	285	739	75	1,099	1,301	3,355
1960:						
Jan. (total)	4,333	6,823	156	11,322	10,325	25,943
Passenger Car	3,912	6,006	111	10,030	9,011	22,567
Truck and Bus	421	826	45	1,292	1,315	3,376
Feb. (total)	3,996	6,047	136	10,179	10,772	26,473
Passenger Car	3,569	5,257	78	8,904	9,371	22,972
Truck and Bus	421	789	59	1,275	1,401	3,502
Mar. (total)	3,753	5,827	157	9,737	11,115	27,921
Passenger Car	3,333	5,156	90	8,578	9,679	24,144
Truck and Bus	421	671	67	1,158	1,436	3,777
Apr. (total)	3,584	7,348	182	11,114	10,317	27,401
Passenger Car	3,200	6,558	114	9,872	9,165	23,512
Truck and Bus	385	790	68	1,243	1,352	3,889
May (total)	3,724	7,306	157	11,188	10,779	26,967
Passenger Car	3,361	6,542	78	9,981	9,458	22,985
Truck and Bus	363	764	80	1,207	1,321	3,982
June (total)	3,449	7,892	174	11,515	10,892	26,359
Passenger Car	3,098	7,105	94	10,297	9,559	22,271
Truck and Bus	352	787	80	1,218	1,332	4,088

Source: The Rubber Manufacturers Association, Inc.

Automobile Production in U. S.

(Civilian Production Only)

Year	Passenger Cars	Trucks	Total	Year	Passenger Cars	Trucks	Total
1940	3,692,328	721,637	4,413,965	1950	6,665,836	1,332,263	7,998,099
1941	3,744,500	875,381	4,619,681	1951	5,337,729	1,420,432	6,758,161
1942	220,814	133,083	353,897	1952	4,320,794	1,212,790	5,533,584
1943	0	4,501	4,501	1953	6,121,787	1,202,196	7,323,983
1944	0	124,819	124,819	1954	5,558,897	1,038,045	6,596,942
1945	83,792	313,643	397,435	1955	7,920,186	1,245,018	9,165,204
1946	2,148,699	930,760	3,079,429	1956	5,816,109	1,100,417	6,916,525
1947	3,558,178	1,220,634	4,778,812	1957	6,113,344	1,097,006	7,210,350
1948	3,909,270	1,363,856	5,132,090	1958	4,257,812	874,278	5,132,090
1949	5,108,841	1,123,736	6,232,577	1959	5,591,243	1,134,858	6,726,101
1959:							
Jan.	539,451	96,044	635,495	July	548,524	114,687	663,211
Feb.	476,977	99,973	576,950	Aug.	255,831	60,147	315,978
Mar.	575,012	111,355	686,367	Sept.	229,410	79,573	308,983
Apr.	585,789	116,910	702,699	Oct.	537,159	94,993	632,152
May	545,001	114,995	659,996	Nov.	267,829	53,968	321,797
June	554,878	119,544	674,422	Dec.	475,382	72,669	548,051
1960:							
Jan.	676,712	115,268	791,980	July	.....	.....	.....
Feb.	656,579	125,938	782,517	Aug.	.....	.....	.....
Mar.	659,730	131,169	780,899	Sept.	.....	.....	.....
Apr.	588,040	114,596	702,636	Oct.	.....	.....	.....
May	607,191	118,023	727,214	Nov.	.....	.....	.....
June	605,582	111,420	717,002	Dec.	.....	.....	.....

Source: Automobile Manufacturers Association.
Note: Figures are based on factory sales. Revisions are made from time to time in these figures and the latest issue should be consulted for accuracy.

Automotive Inner Tubes

(Thousands of Units)

	Shipments					
Year	Original Equipment	Replacement	Export	Total	Production	Inventory End of Period
1946	15,327	59,357	1,424	76,108	77,251	3,820
1947	25,046	46,560	2,483	74,088	79,181	8,059
1948	26,833	40,548	1,119	68,499	70,033	9,641
1949	31,521	31,450	887	63,858	65,114	10,657
1950	41,240	42,671	811	84,723	80,179	.....
1951	32,151	32,284	1,071	65,507	67,249	10,094
1952	29,451	32,985	1,014	63,449	65,073	12,036
1953	37,957	36,072	878	74,907	74,425	11,874
1954	25,071	35,576	945	61,593	48,279	9,519
1955	5,001	33,387	1,001	39,389	35,900	6,833
1956	3,100	32,358	1,040	36,498	34,405	6,109
1957	3,046	35,687	1,076	39,806	39,774	80,077
1958	2,678	37,872	870	41,420	41,266	8,602
1959	3,624	41,522	891	46,037	46,059	10,536
1959:						
Nov.	163	2,867	67	3,097	3,756	9,918
Dec.	240	2,793	102	3,135	3,612	10,536
1960:						
Jan.	365	4,964	62	5,391	3,899	8,924
Feb.	370	3,554	87	4,011	4,043	9,002
Mar.	365	2,807	111	3,282	4,241	10,113
Apr.	330	2,862	114	3,306	3,628	10,495
May	307	2,932	91	3,330	3,611	10,852
June	295	3,154	98	3,547	3,444	10,700

Source: The Rubber Manufacturers Association, Inc.

Vinyl and Vinyl Copolymer Resins—Sales

(Thousands of Pounds—Resin Content)

	Polyvinyl Chloride and Copolymer Resins							All Other Vinyl Resins		
	Film	Sheeting	Molding & Extrusion	Textile & Paper Treating	Flooring	Protective Coatings	All Other Uses	Adhesives	All Other Uses	Grand Total
1953	**63,691**	**62,385**	**129,215**	**52,353**	**22,152**	**22,823**	**27,790**	**22,411**	**77,478**	**480,299**
1954	**69,943**	**56,588**	**147,284**	**49,546**	**34,890**	**23,676**	**35,148**	**26,609**	**74,090**	**517,773**
1955	**83,276**	**51,424**	**183,736**	**64,223**	**56,357**	**27,439**	**53,868**	**31,853**	**105,644**	**657,821**
1956	**78,063**	**55,598**	**206,726**	**62,931**	**65,384**	**28,522**	**71,859**	**36,565**	**115,151**	**720,799**
1957	**90,543**	**56,344**	**216,517**	**66,392**	**81,357**	**31,519**	**50.637**	**41,665**	**113,396**	**748,370**
1958	**72,404**	**67,594**	**214,701**	**63,050**	**113,583**	**28,913**	**68,307**	**52,904**	**117,752**	**801,208**
1959	**85,136**	**125,639**	**304,711**	**64,703**	**151,840**	**31,371**	**94,418**	**57,599**	**159,528**	**1,074,945**
1959:										
Dec.	7,360	11,923	22,604	4,151	11,482	2,443	9,886	4,705	12,215	86,769
1960:										
Jan.	8,846	10,244	21,253	5,012	12,989	2,715	8,151	4,551	12,433	86,194
Feb.	9,044	10,382	24,234	5,019	13,722	2,602	7,585	4,811	13,849	91,248
Mar.	9,106	10,294	25,663	5,127	14,718	3,171	9,510	6,149	14,652	108,390
Apr.	8,272	10,816	22,835	5,157	12,811	3,431	8,482	4,797	12,644	89,245
May	7,610	11,623	24,221	5,466	13,103	3,449	8,194	4,891	12,555	91,112
June	8,869	12,074	23,683	5,332	12,489	3,846	11,534	5,265	11,711	94,803

Source: Chemical Division, U. S. Tariff Commission.

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Texas U.S. Chemical Co.
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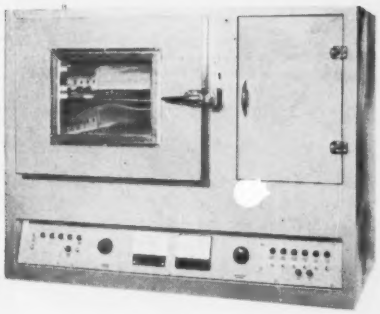
Shell Chemical Corporation



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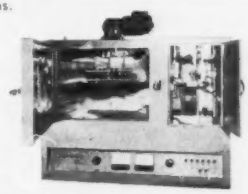

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Various Compounding Materials Consumed by the Rubber Industry

Material	1952	1953	1954	1955	1956	1957	1958
Antimony, Primary							
Short tons	66c	20c	49c	78	156	284	265
% of total	.004	.001	.004	.006	.010	.024	.022
Asphalt: [a]							
Short tons	33,288	.....	.....	.....	.....	.....	.....
% of total	0.4	.....	.....	.....	.....	.....	.....
Barite (Barytes):							
Short tons	18,000	21,000	20,000	25,104	22,101	21,782	18,387
% of total	2.0	2.0	2.0	2.0	2.0	1.0	2.0
Short tons	537,273	566,797	511,831	643,430	622,325	635,781	625,469
Carbon Black:							
% of total	93.1	94.4	93.5	93.5	95.5	45.5	95.3
Clay, Kaolin:							
Short tons	240,982	241,052	247,431	257,223	268,157	301,185	282,493
% of total	13.2	12.8	13.2	11.9	12.0	14.0	17.1
Clay, Fire & Stoneware:							
Short tons	9,322	18,475	8,781	2,928	.....	.....	.....
% of total	0.1	.2	.1	.2	.....	.....	.....
Lime:							
Short tons	2,000	1,631	1,555	1,465	2,487	2,799	2,533
% of total	(d)	(d)	(d)	(d)	(d)	(d)	(d)
Litharge:							
Short tons	2,109	2,230	1,768	1,947	2,266	1,298	1,247
% of total	1.1	1.4	1.3	1.3	1.7	1.7	1.4
Lithopone:							
Short tons	1,523	1,723	1,701	2,163	2,000[e]	.....	.....
% of total	2.5	3.3	3.9	5.0	5.0	.....	.....
Mica, Ground:							
Short tons	5,126	5,668	5,021	7,339	7,021	8,579	9,622
% of total	7.0	7.8	6.3	6.9	8.0	9.0	9.9
Sulfur:							
Short tons	84,000	89,600	84,000	89,600	89,600	89,600[e]	.....
% of total	1.4	1.4	1.3	1.2	1.1	1.1	.....
Talc: [b]							
Short tons	64,476	61,408	58,139	38,309	30,253	28,532	36,889
% of total	10.9	10.0	9.7	5.4	5.0	6.0	6.5
Zinc Oxide:							
Short tons	72,774	78,439	71,058	86,677	80,459	81,745	68,176
% of total	51.2	52.7	50.7	51.5	51.9	54.0	46.5

Source: U. S. Bureau of Mines.
Notes: (a) Solid and semi-solid products of less than 200 penetration. (b) Includes prophyllite and ground soapstone. (c) Does not include precipitated antimony sulfide as in previous years. (d) Negligible. (e) Estimated.

Reclaimed Rubber
(Including Natural and Synthetic)
(All Quantities in Long Tons)

Year	New Supply	Consumption: Tons	Consumption: % to Crude [a]	Exports	Stocks On Hand at End of Period
1941	274,202	251,231	32.2	13,851	41,750
1942	286,00/ [b]	254,820	64.6	30,405	42,532
1943	304,058 [c]	291,082	59.6	15,678	46,201
1944	260,631 [d]	251,083	35.3	11,800	43,832
1945	243,309	241,036	30.2	13,413	28,155
1946	295,612	275,410	26.5	14,461	33,666
1947	291,395	288,395	24.8	14,556	35,943
1948	266,861	261,113	24.4	11,428	32,630
1949	224,029	226,679	22.5	10,637	28,263
1950	314,008	303,733	24.1	11,740	35,708
1951	366,700	346,121	26.6	14,722	45,082
1952	274,981	280,002	22.2	11,180	30,664
1953	298,336	285,050	21.3	11,597	32,319
1954	258,101	249,049	20.2	10,232	30,746
1955	326,649	312,781	20.4	13,988	31,498
1956	287,220	270,547	13.8	13,832	34,969
1957	271,647	267,352	18.2	13,021	29,323
1958	259,809	248,156	18.2	11,362	29,063
1959	303,479	286,410	20.0	11,757	27,738
1959:					
May	19,441	20,496	18.1	980	23,554
June	26,169	24,998	17.9	1,054	23,448
July	27,884	23,942	16.9	1,236	25,949
Aug.	25,276	22,914	16.6	879	26,165
Sept.	28,130	25,137	17.2	937	27,384
Oct.	28,255	26,022	17.6	964	27,393
Nov.	22,525	20,217	16.1	909	28,526
Dec.	23,720	22,962	17.4	1,055	27,738
1960:					
Jan.	26,532	26,540	18.9	1,106	29,031
Feb.	27,085	25,944	18.6	1,258	28,653
Mar.	29,114	26,625	18.4	1,542	29,719
Apr.	26,221	24,210	18.2	1,248	30,916
May	25,676	23,763	17.8	....	32,611

Source: U. S. Department of Commerce.
Notes: (1) These figures are revised from time to time and the latest available issue should be consulted for the most accurate data. (a) Includes natural and synthetic rubber. (b) Includes 893 tons of imports. (c) Includes 67 tons of imports. (d) Includes 21 tons of imports.

Cotton, Rayon and Nylon Tire Fabrics
(In Thousands of Pounds)

	Production: Rayon Tire Cord Net Woven	Production: Rayon Tire Cord Woven	Production: Cotton and Nylon Cord & Fabric [a]	Production: Chafer Fabrics (all fibers)	Production: Total Tire Cord and Fabric	Stocks [b]: Cotton and Nylon Cord & Fabric	Stocks [b]: Rayon Cord and Fabric
1958:							
Jan.-Mar.	8,372	56,522	25,647	7,367	92,924	11,255	33,913
Apr.-June	.....	.....	30,745	6,020	80,533	11,274	26,327
July-Sept.	.....	.....	31,371	6,467	91,984	11,229	26,428
Oct.-Dec.	.....	.....	34,858	8,466	107,532	12,251	25,936
Total	8,372	56,522	122,621	28,320	372,973	46,009	112,604
1959:							
Jan.-Mar.	77,307	77,307	41,565	9,163	122,661	14,025	22,093
Apr.-June	76,265	76,265	37,102	7,699	116,965	16,811	31,094
July-Sept.	76,671	76,671	39,863	8,318	119,748	14,040	35,152
Oct.-Dec.	.....	.....	.....	.....	.....	.....	.....
Total	.....	.....	.....	.....	.....	.....	.....

Source: Bureau of the Census, U. S. Department of Commerce.
Notes: (a) Combined to avoid disclosing figures for individual companies. (b) At end of period.

Gasoline Consumption
(In Thousands of Barrels of 42 Gallons)

	1954	1955	1956	1957	1958	1959	1960
Jan.	89,634	96,397	100,642	109,295	107,281	114,720	111,311
Feb.	86,206	88,464	98,088	96,694	95,516	99,759	108,871
Mar.	101,549	105,684	112,412	113,166	108,914	118,995	120,497
Apr.	103,866	111,116	113,034	115,820	118,477	124,917	129,094
May	104,418	115,707	123,560	124,325	125,137	127,049	129,952
June	113,037	120,710	126,833	121,598	125,444	133,695	.....
July	112,231	115,653	120,708	130,251	130,903	137,141	.....
Aug.	110,223	121,816	125,847	128,808	129,925	132,875	.....
Sept.	104,706	113,379	111,574	113,567	120,389	130,264	.....
Oct.	105,607	112,558	119,204	119,334	125,097	120,858	.....
Nov.	102,393	109,212	112,113	107,705	110,587	116,056	.....
Dec.	104,258	111,034	108,096	112,691	120,305	123,587	.....
Total	1,238,346	1,321,730	1,372,116	1,393,254	1,417,975	1,479,907	.....

Source: U. S. Bureau of Mines.

U. S. Gross Imports of Balata, Jelutong, Gutta-Percha, etc.
(All Quantities in Long Tons)

Year	Balata: Tons	Balata: Value	Jelutong: Tons	Jelutong: Value	Gutta-Percha & Other Guttas: Tons	Gutta-Percha & Other Guttas: Value
1945	1,361	907,253	....	.....	36	21,970
1946	2,281	2,233,065	304	256,169	423	458,064
1947	1,982	2,276,531	2,878	1,496,887	392	779,591
1948	1,195	805,078	3,401	2,377,765	423	542,788
1949	1,391	814,354	1,043	834,978	197	189,021
1950	2,117	1,589,885	1,789	1,515,162	541	745,418
1951	2,452	1,973,271	1,669	2,608,359	383	430,539
1952	988	762,994	1,636	2,094,983	282	385,890
1953	1,619	866,248	1,027	1,166,837	235	303,116
1954	949	504,065	2,196	2,624,926	417	511,055
1955	1,022	967,369	1,679	1,731,821	284	318,115
1956	1,396	1,111,165	1,851	1,909,447	290	309,615
1957	1,037	670,821	1,680	1,942,067	230	270,487
1958	745	536,820	1,501	1,698,840	157	224,490
1959	1,512	1,350,843	1,296	1,608,986	268	311,178
1960:						
Jan.	144	219,497	84	100,515	47	57,798
Feb.	37	38,260	165	143,255	12	12,855
Mar.	47	42,000	37	44,269	4	15,197
Apr.	56	35,560	97	104,711	18	33,181
May	86	79,553	76	88,209	64	90,252

Source: U. S. Department of Commerce.

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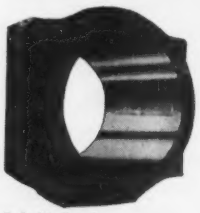

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Be Accurate: Call it PARA-FLUX® only if it came from The C. P. Hall Company

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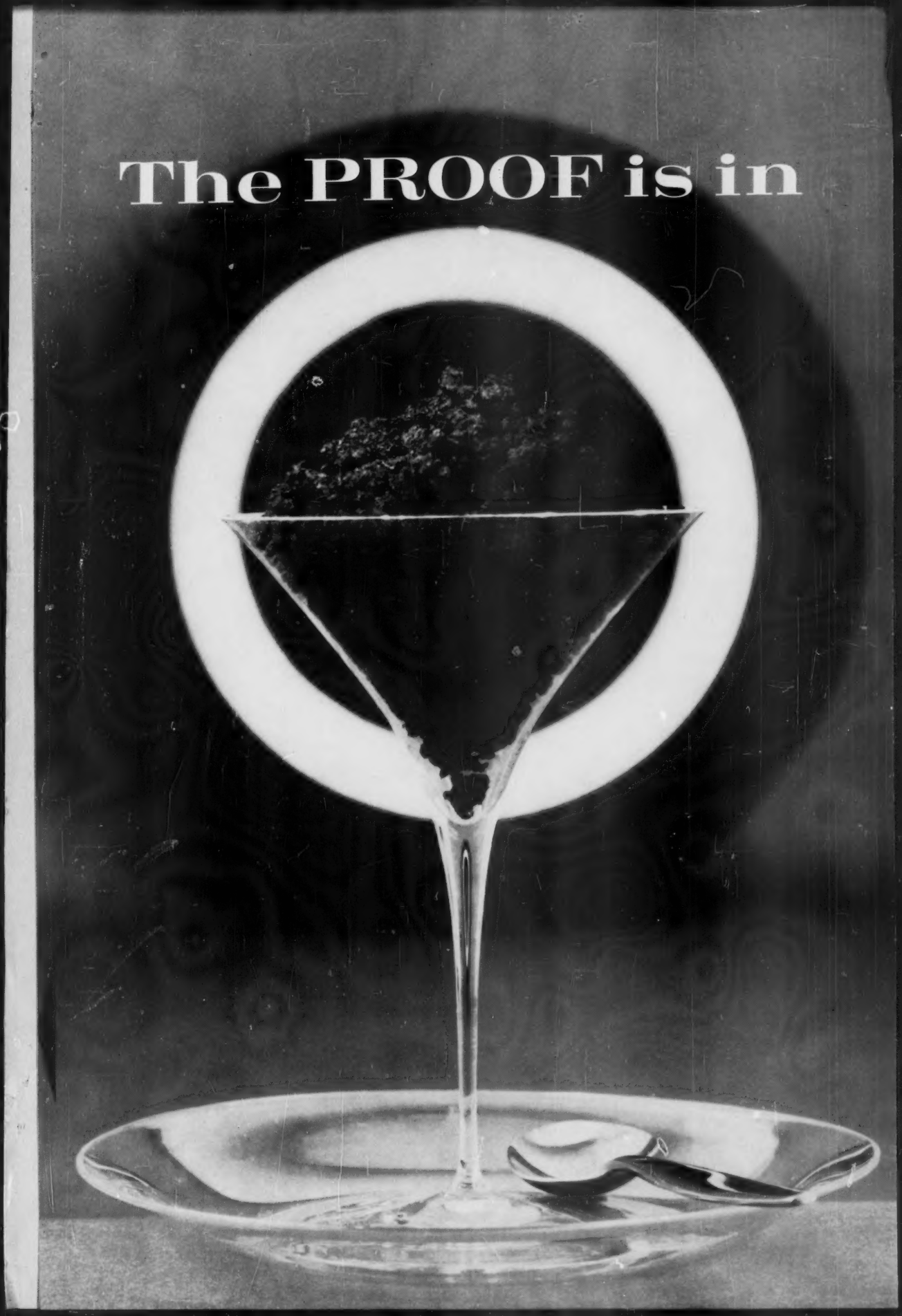
The PROOF is in



~~the pudding~~

the black maste

NOW from Baytown

A dispersa

Made by a NEW manufacturing

The new United-Barclay technique* makes possible this improved product potential. Baytown's traditionally superior product uniformity, processibility and ease of handling have been increased.

In addition –

These new dispersant-free SBR black masterbatches, tested on independent tracks, have shown wear ratings that are second to none.

Each of these new tread, carcass and mechanical goods black masterbatches offer improved extrusion and excellent physicals.

The final proof of this new product potential ultimately lies in your hands. Larger than "pudding-size" (i.e. truckloads for instance) samples are ready for your testing. Please contact your United Carbon representative or write to – United Carbon Company, Inc., 410 Park Ave., New York 22, N. Y.

*Patents Pending

erbatch products

sant-free product that is completely salt free

g technique.

BAYTOWN'S 8675 FOR TREAD STOCK

100 parts SBR copolymer
50 parts HAF black
9 parts naphthenic oil
rosin/staining

BAYTOWN'S 8677 FOR TREAD STOCK

100 parts SBR copolymer
52 parts HAF black
10 parts high aromatic oil
rosin/staining

BAYTOWN'S 8775 FOR TREAD STOCK

100 parts SBR copolymer
75 parts HAF black
37.5 parts aromatic oil
mixed/staining

BAYTOWN'S 8750 FOR CARCASS, SIDEWALL AND MECHANICAL GOODS

100 parts SBR copolymer
50 parts SRF black
17.5 parts high aromatic oil
rosin/staining

BAYTOWN'S 8776 FOR EXTRUSIONS AND MECHANICAL RUBBER GOODS

100 parts SBR copolymer
50 parts HAF black
37.5 parts naphthenic oil
mixed/non-staining

BAYTOWN: THE BIRTHPLACE OF MASTERBATCH

UNITED CARBON COMPANY, INC.
410 PARK AVENUE, NEW YORK 22, N. Y.
A Subsidiary of United Carbon Company
AKRON CHICAGO LOS ANGELES
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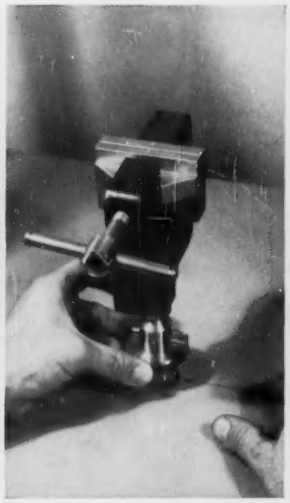
You can change a complete set of test clamps on a Scott Tester... in a matter of seconds!

Here's how:

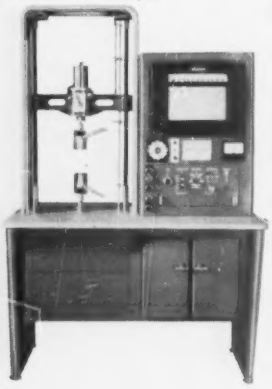
2 sec. Locking pin out — top clamp off

4 sec. New clamp in position — pin replaced

6 sec. Locking pin out — bottom clamp off



8 sec. New clamp on . . . pin replaced . . . locking collar tightened. That's all — start testing!



It's simple arithmetic! With Scott Testers' exclusive new quick-change clamp assembly, you can now replace clamps in a *matter of seconds,* speed up your test operations, make more tests a day! Moreover, the Scott Model CRE Constant-Rate-of-Extension Tester offers you this time-saving convenience *plus* ultra-precise testing . . . with automatic push-button controls, and an error-free electronic weighing system that enables even the non-technical operator to make tests easier, faster, and at amazingly low cost!

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